Figure 8.10 a & b The Structure of Lithium Fluoride

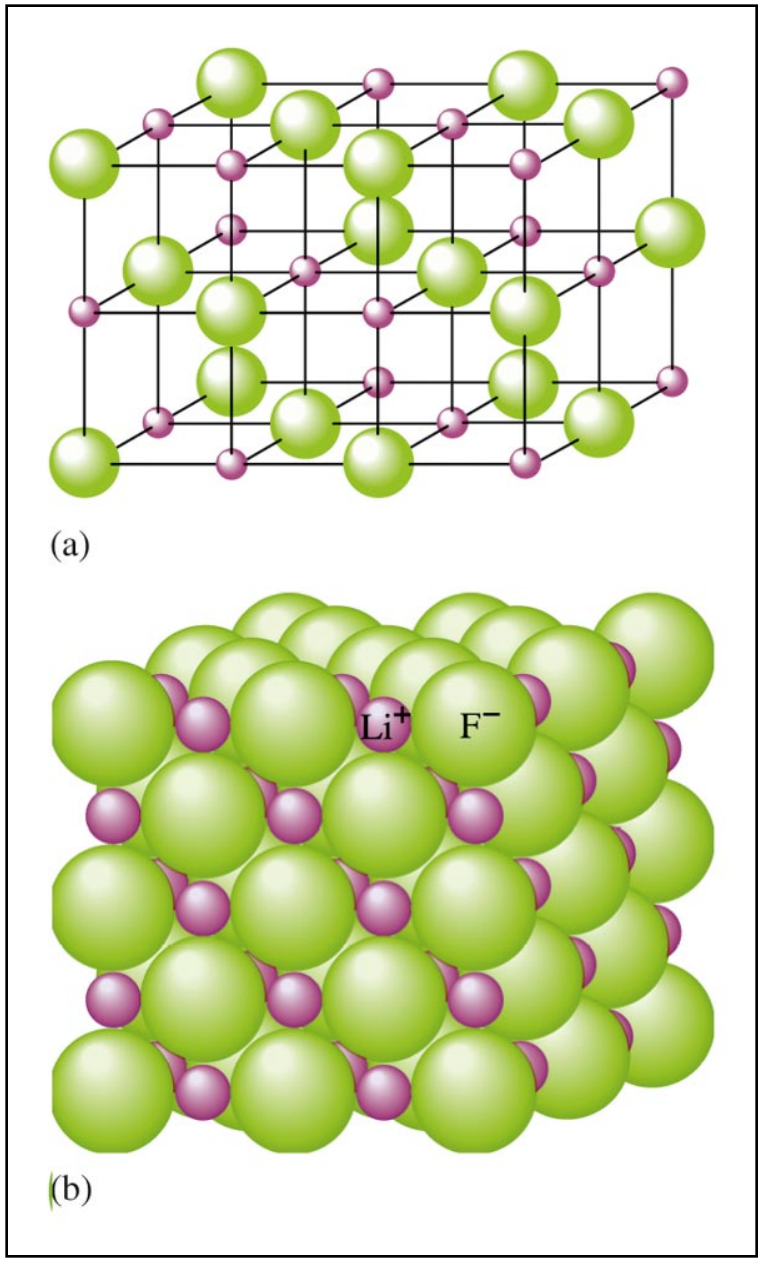


Figure 8.1 a & b (a) The Interaction of Two Hydrogen Atoms (b) Energy Profile as a Function of the Distance Between the Nuclei of the Hydrogen Atoms

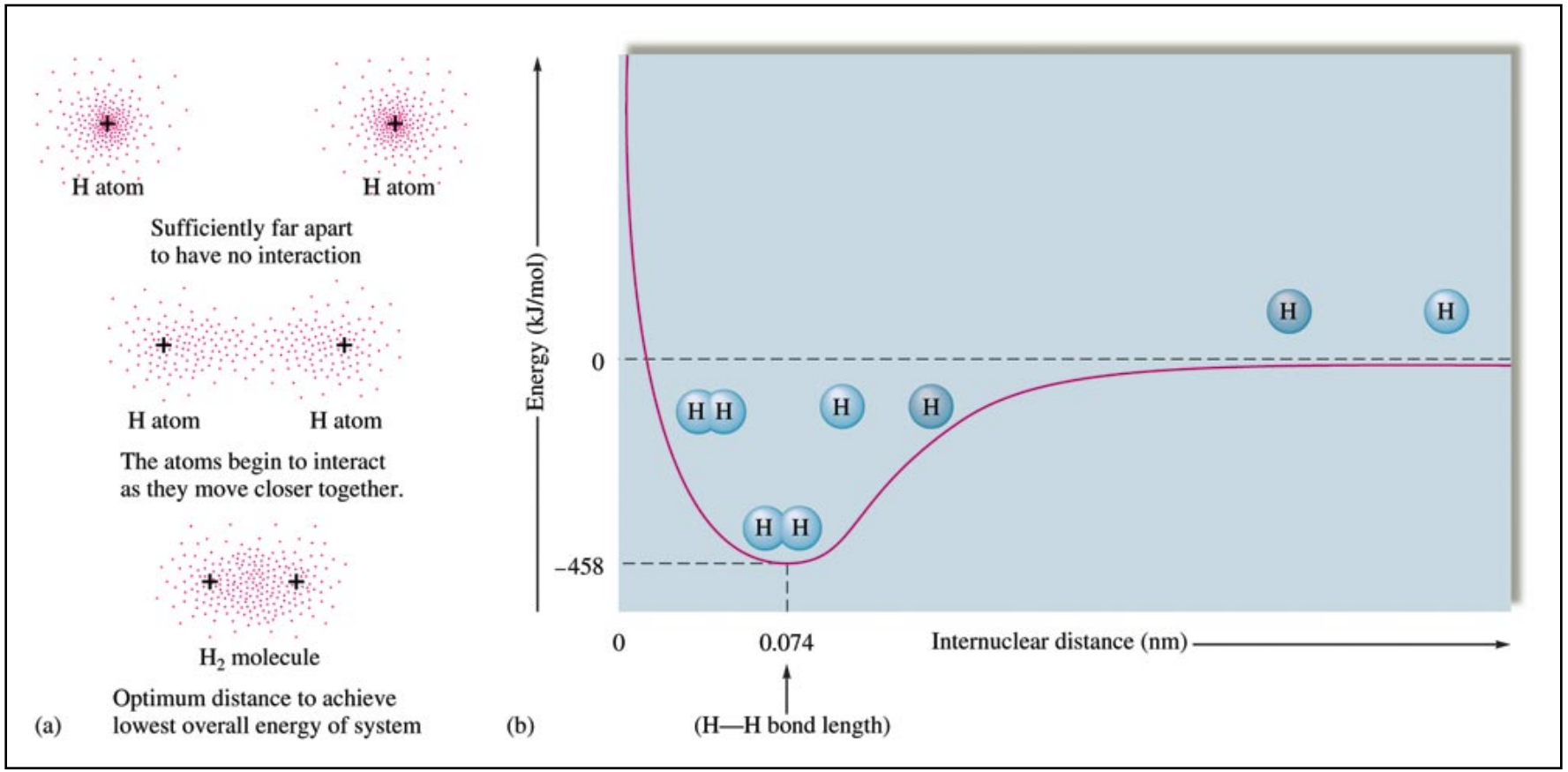


Figure 8.2 The Effect of an Electric Field on Hydrogen Fluoride Molecules

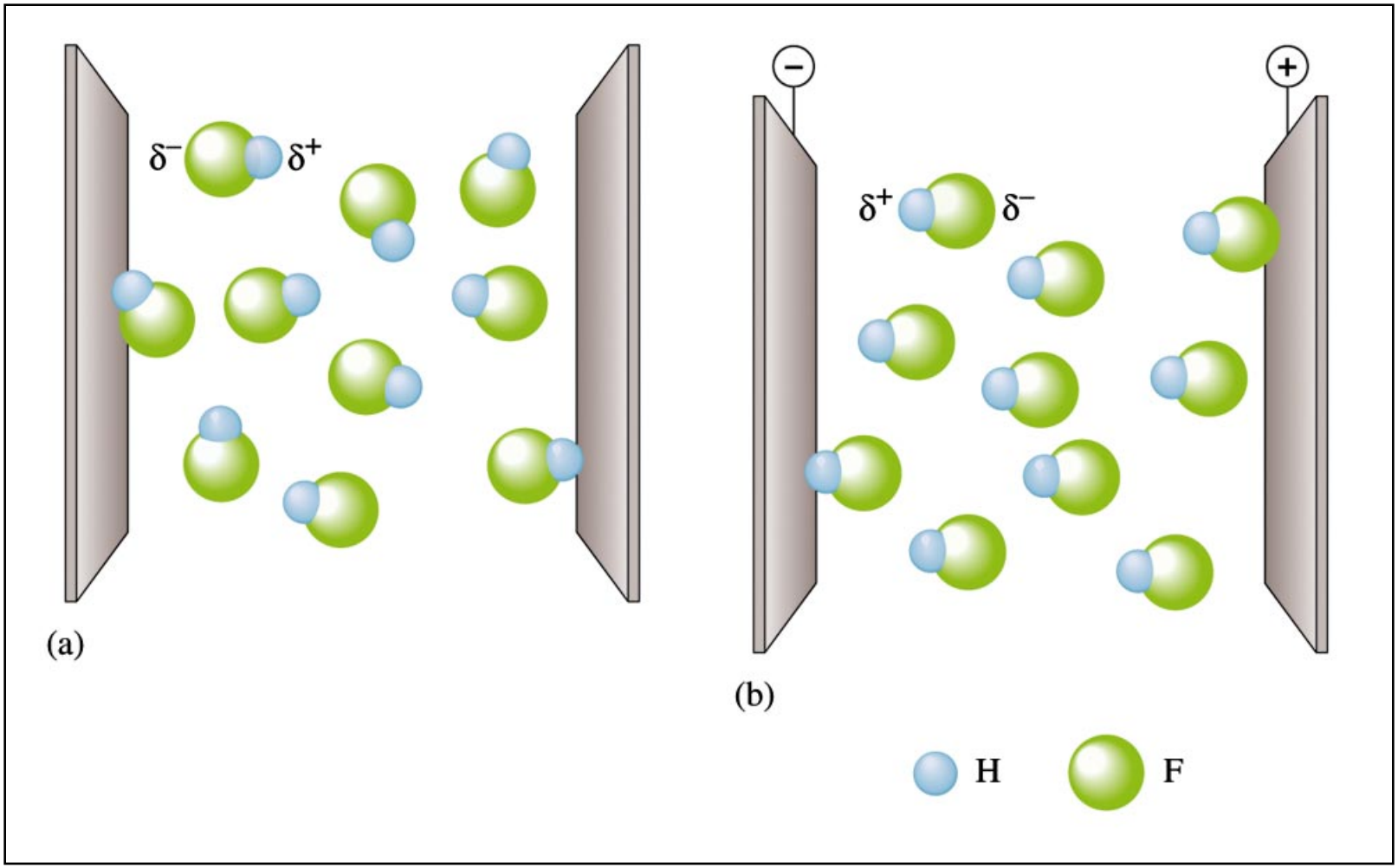


Figure 8.3 The Pauling Electronegativity Vaules

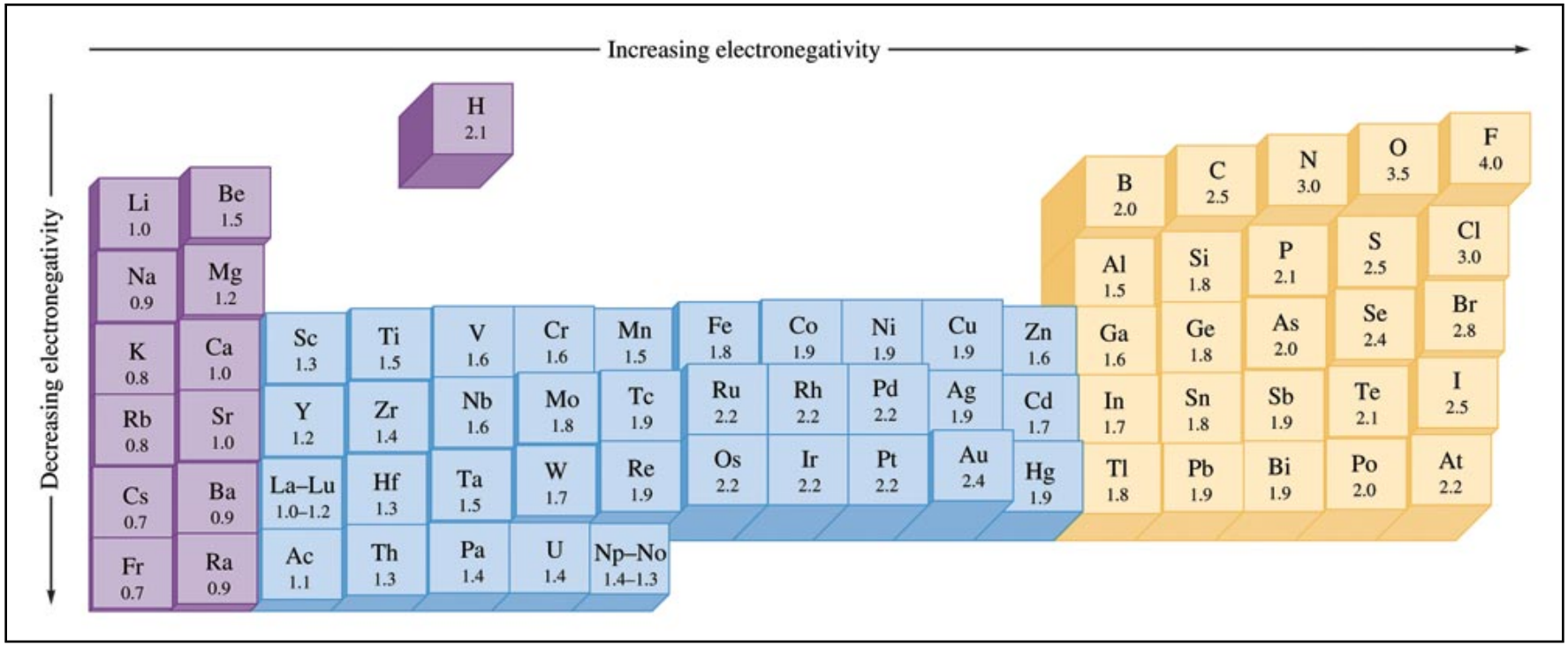


TABLE 8.1 The Relationship Between Electronegativity and Bond Type

Electronegativity Difference in the Bonding Atoms	Bond Type
Zero	Covalent
↓	↓
Intermediate	Polar covalent
↓	↓
Large	Ionic

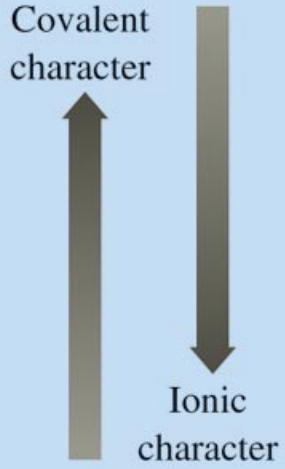


Figure 8.4 An Electrostatic Potential Map of HF

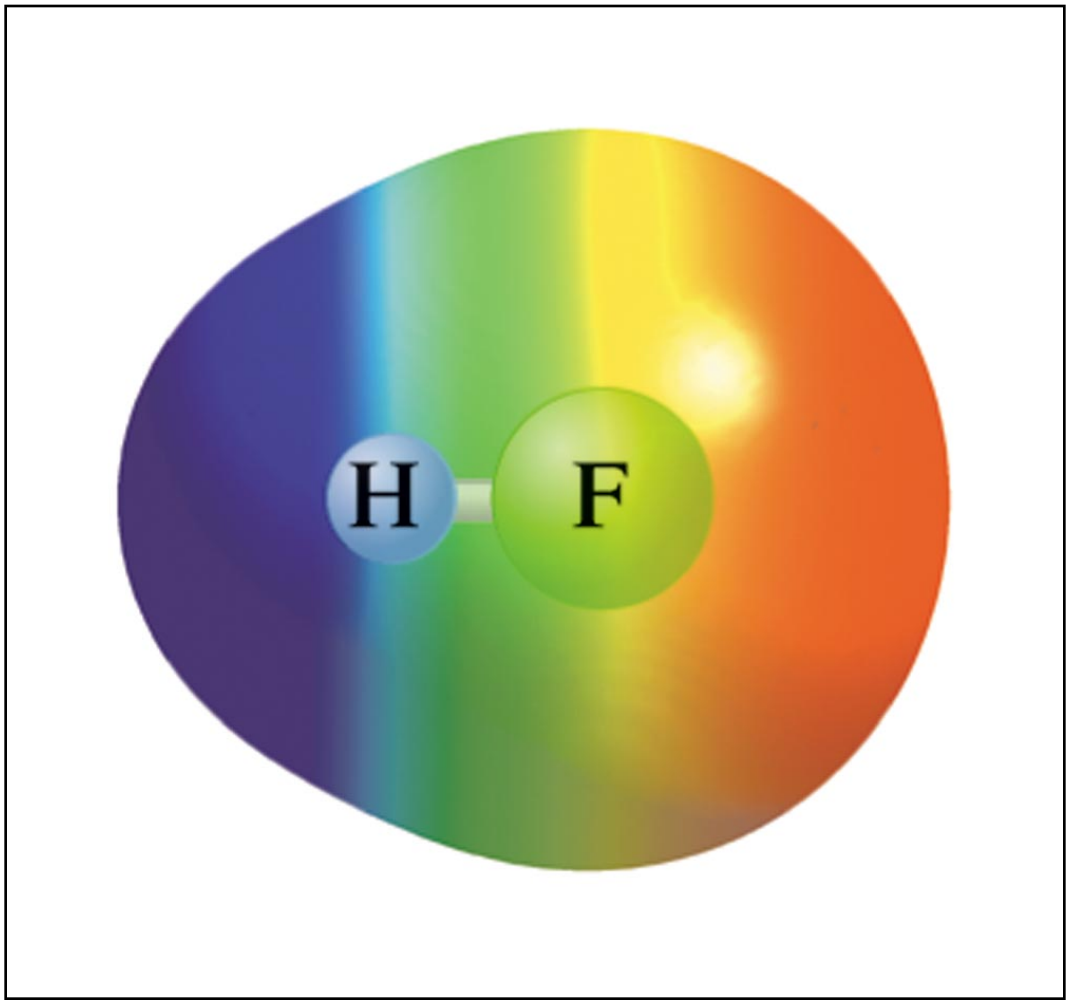


Figure 8.5 a-c The Charge Distribution in the Water Molecule

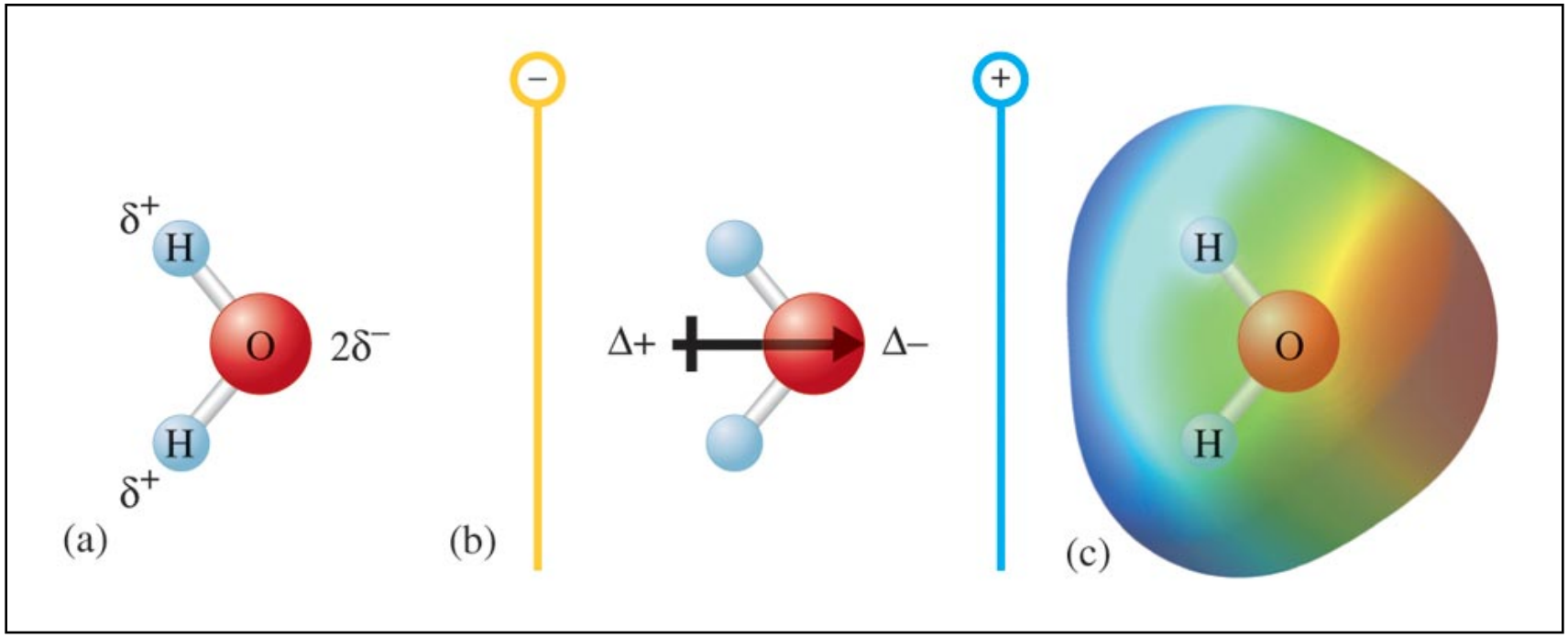


Figure 8.6 a-c The Structure and Charge Distribution of the Ammonia Molecule

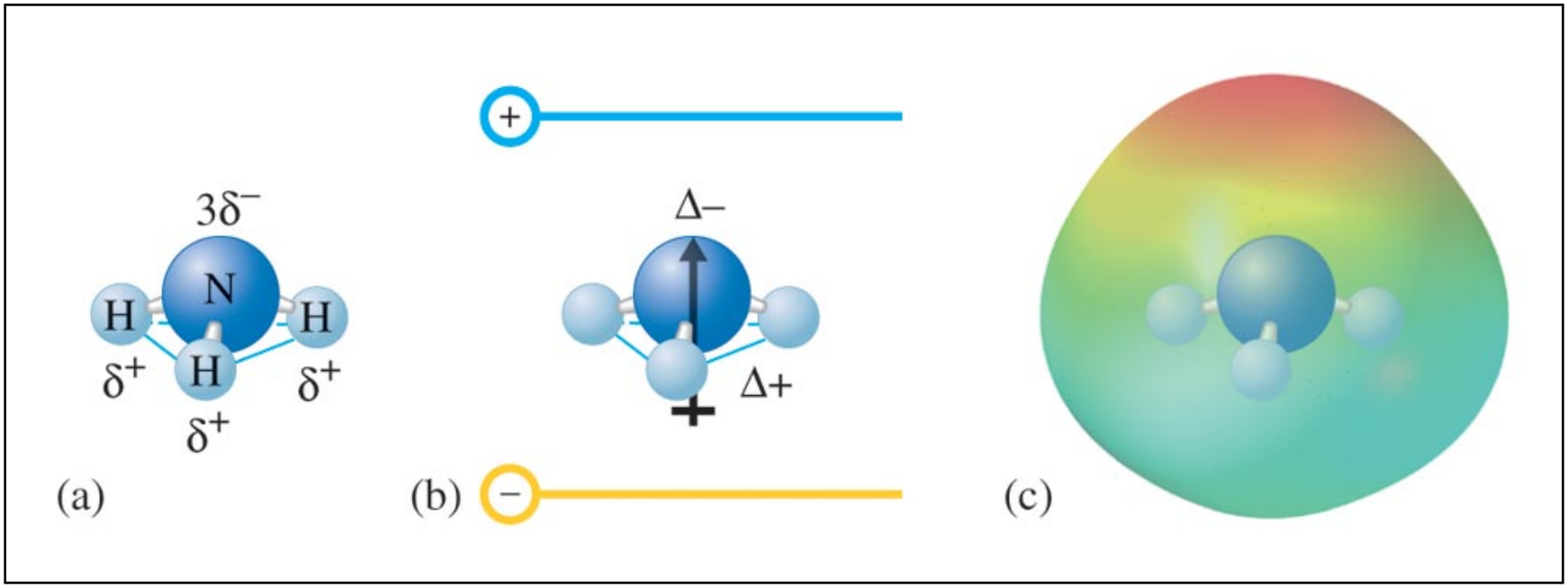
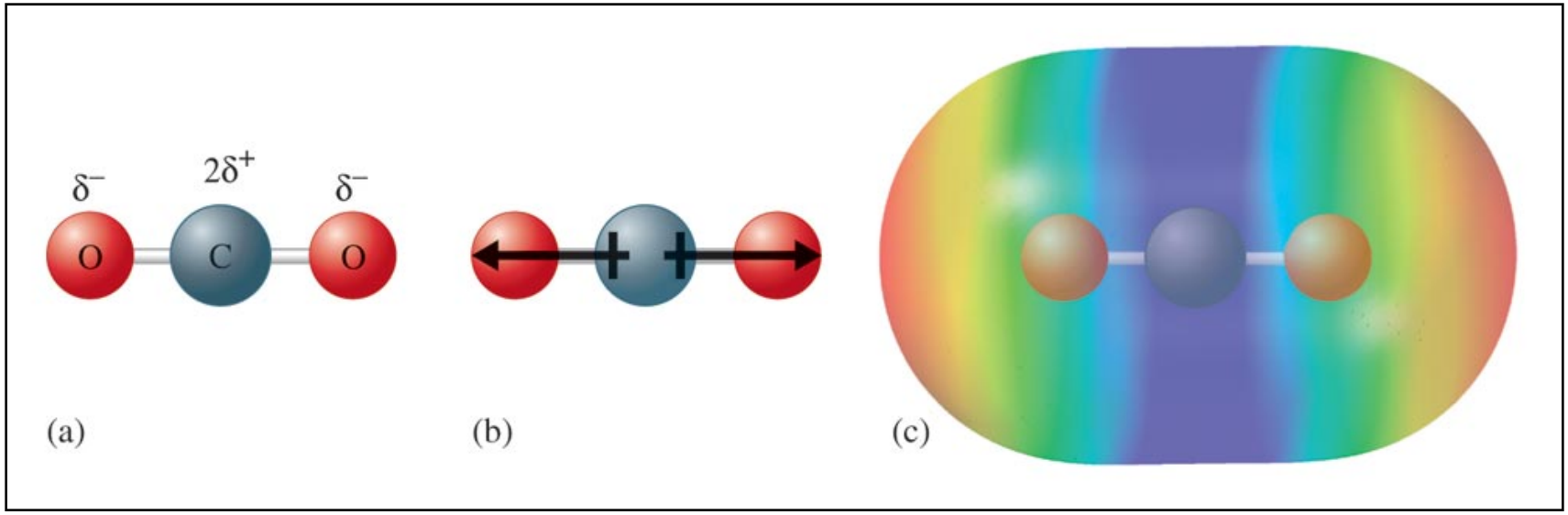
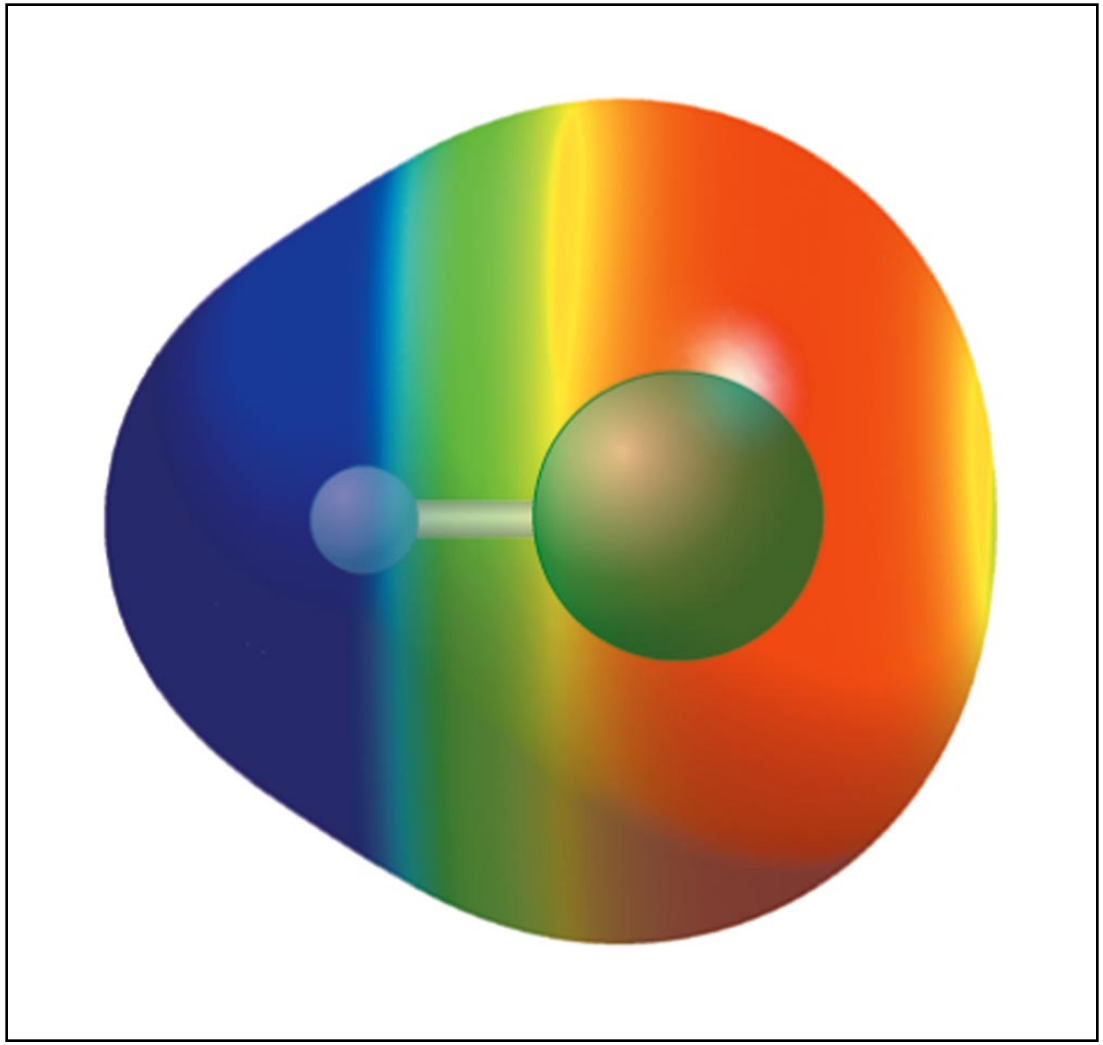


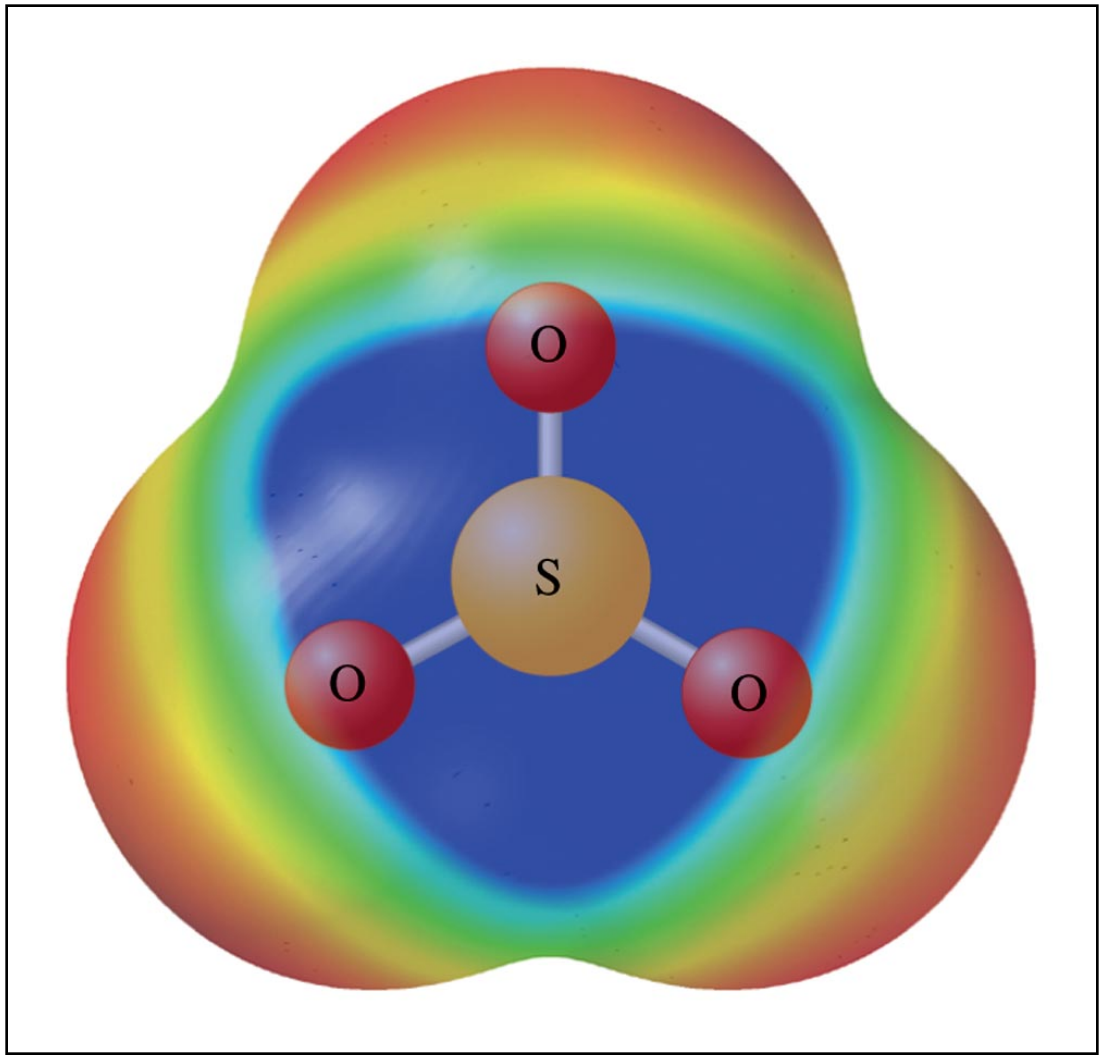
Figure 8.7 a-c The Carbon Dioxide Molecule



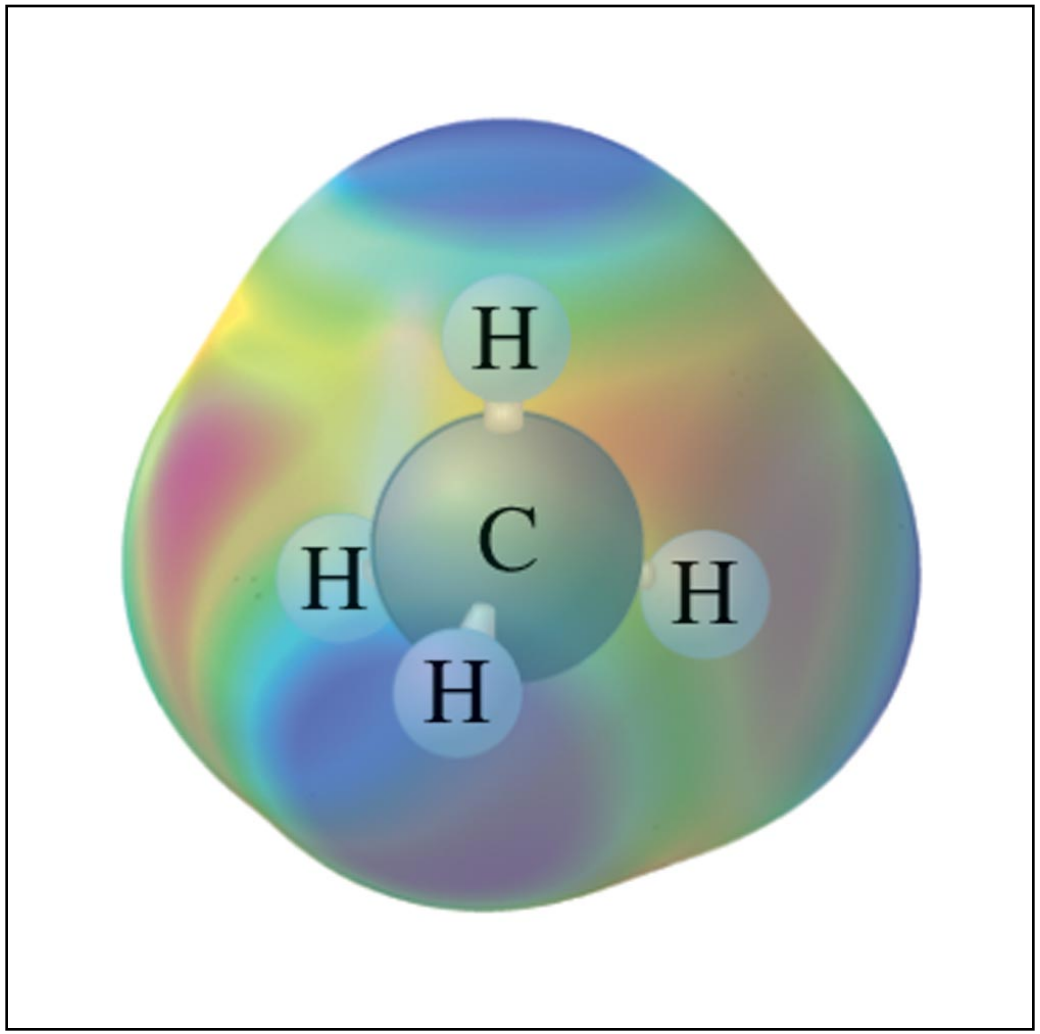
e.p. Diagram HCl



e.p.Diagram SO_3



e.p. Diagram CH_4



e.p. Diagram H_2S

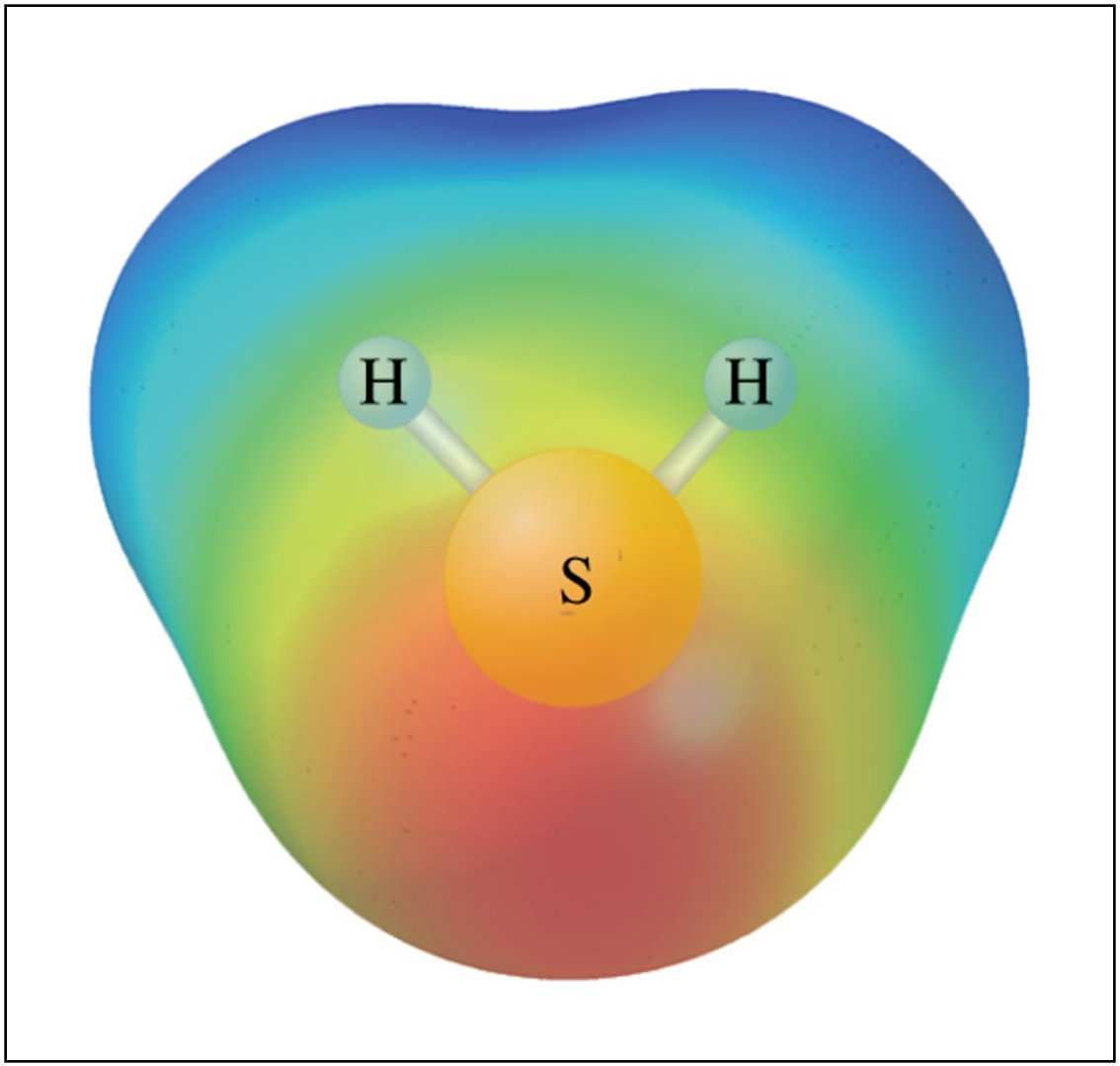


TABLE 8.2 Types of Molecules with Polar Bonds but No Resulting Dipole Moment

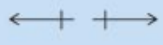
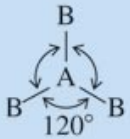
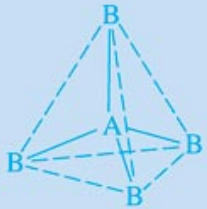
Type			Cancellation of Polar Bonds	Example	Ball-and-Stick Model
Linear molecules with two identical bonds	B—A—B	CO_2			
Planar molecules with three identical bonds 120 degrees apart				SO_3	
Tetrahedral molecules with four identical bonds 109.5 degrees apart				CCl_4	

Figure 8.9 The Energy Changes Involved in the Formation of Lithium Fluoride from Its Elements

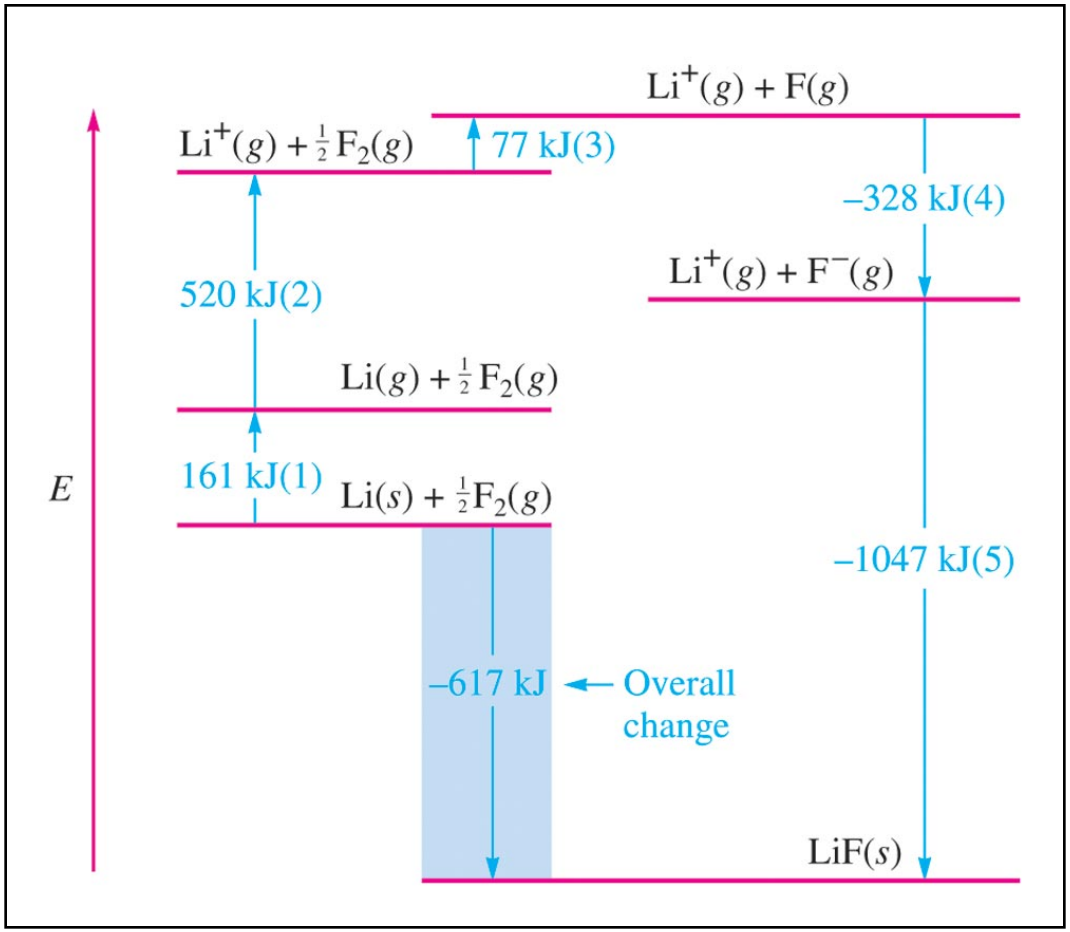


Figure 8.10 a & b The Structure of Lithium Fluoride

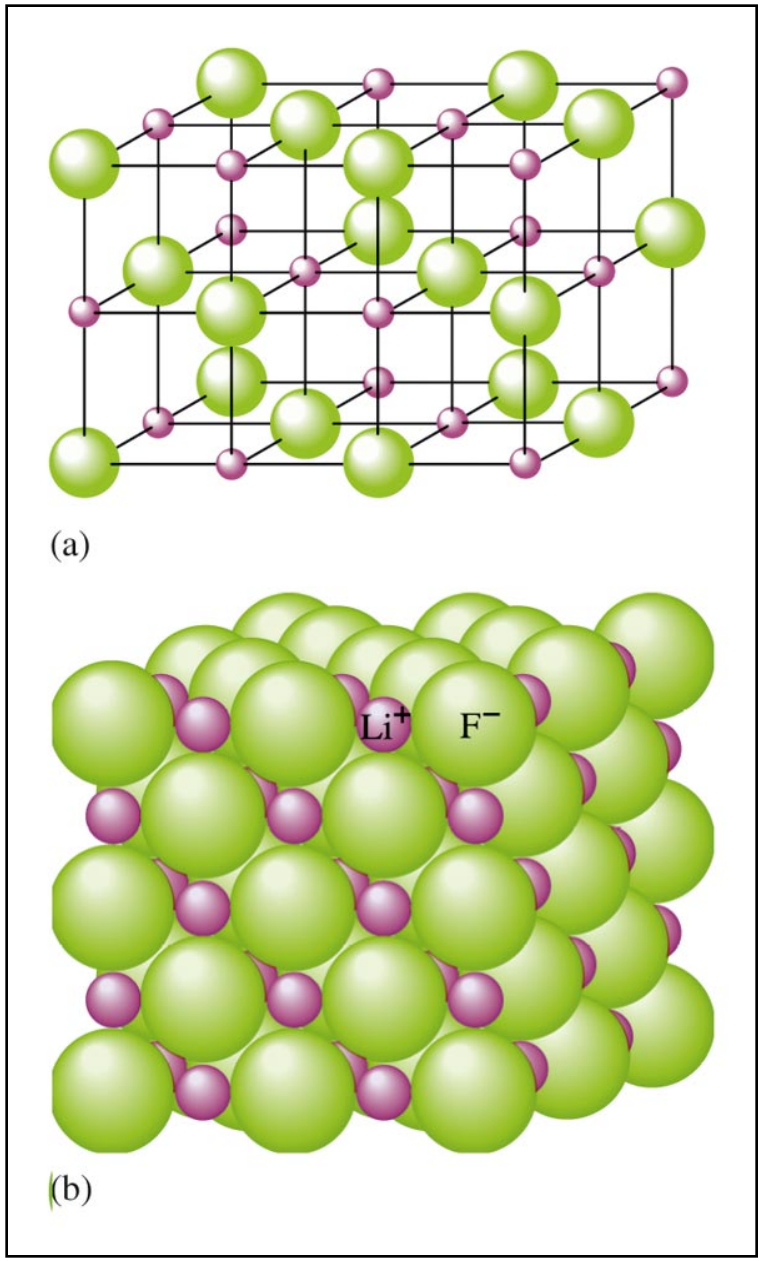


Figure 8.11 Comparison of the Energy Changes Involved in the Formation of Solid Sodium Fluoride and Solid Magnesium Oxide

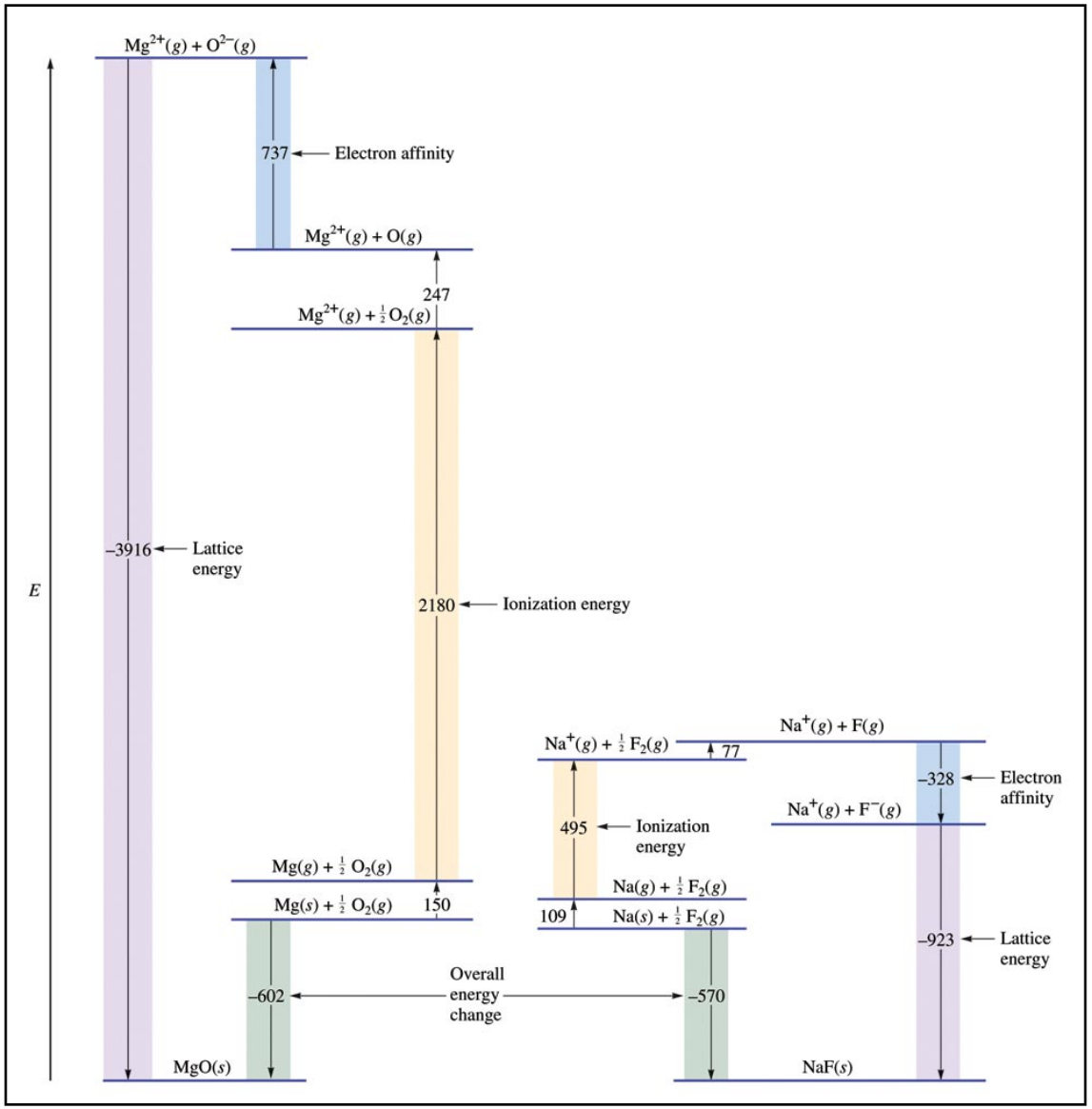


TABLE 8.4 Average Bond Energies (kJ/mol)

Single Bonds						Multiple Bonds	
H—H	432	N—H	391	I—I	149	C=C	614
H—F	565	N—N	160	I—Cl	208	C≡C	839
H—Cl	427	N—F	272	I—Br	175	O=O	495
H—Br	363	N—Cl	200			C=O*	745
H—I	295	N—Br	243	S—H	347	C≡O	1072
		N—O	201	S—F	327	N=O	607
C—H	413	O—H	467	S—Cl	253	N=N	418
C—C	347	O—O	146	S—Br	218	N≡N	941
C—N	305	O—F	190	S—S	266	C≡N	891
C—O	358	O—Cl	203			C=N	615
C—F	485	O—I	234	Si—Si	340		
C—Cl	339			Si—H	393		
C—Br	276	F—F	154	Si—C	360		
C—I	240	F—Cl	253	Si—O	452		
C—S	259	F—Br	237				
		Cl—Cl	239				
		Cl—Br	218				
		Br—Br	193				

*C=O(CO_2) = 799

TABLE 8.5 Bond Lengths for Selected Bonds

Bond	Bond Type	Bond Length (pm)	Bond Energy (kJ/mol)
C—C	Single	154	347
C=C	Double	134	614
C≡C	Triple	120	839
C—O	Single	143	358
C=O	Double	123	745
C—N	Single	143	305
C=N	Double	138	615
C≡N	Triple	116	891

Use the the table of Bond Energies to calculate the ΔH for the following reaction.

$$CH_4 + 2Cl_2 + 2F_2 \rightarrow CF_2Cl_2 + 2HF + 2HCl$$

Ans = -1194 kJ

TABLE 9.2 Electron-Domain Geometries and Molecular Shapes for Molecules with Two, Three, and Four Electron Domains Around the Central Atom

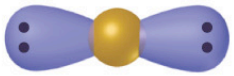
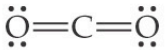
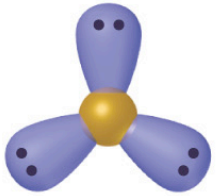
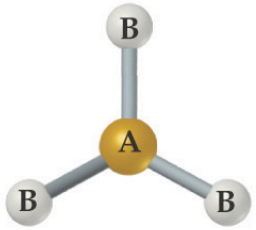
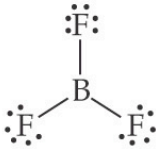
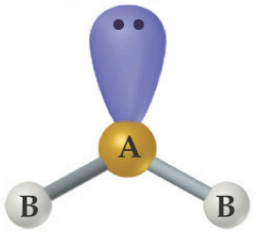
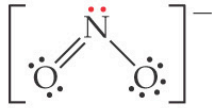
Number of Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
2	 Linear	2	0	 Linear	
3	 Trigonal planar	3	0	 Trigonal planar	
		2	1	 Bent	

TABLE 9.2 Electron-Domain Geometries and Molecular Shapes for Molecules with Two, Three, and Four Electron Domains Around the Central Atom

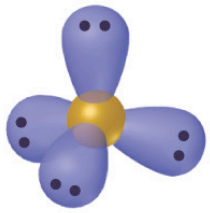
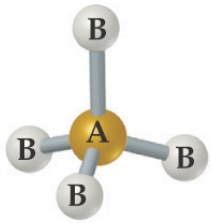
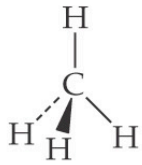
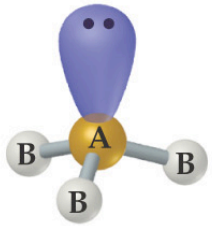
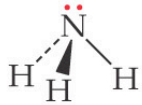
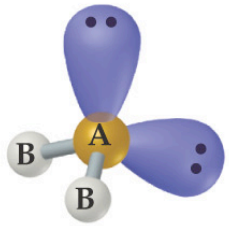
Number of Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
4	 Tetrahedral	4	0	 Tetrahedral	
		3	1	 Trigonal pyramidal	
		2	2	 Bent	

Figure 8.18 The Bond Angles In the CH4, NH_3, and H_20 Molecules

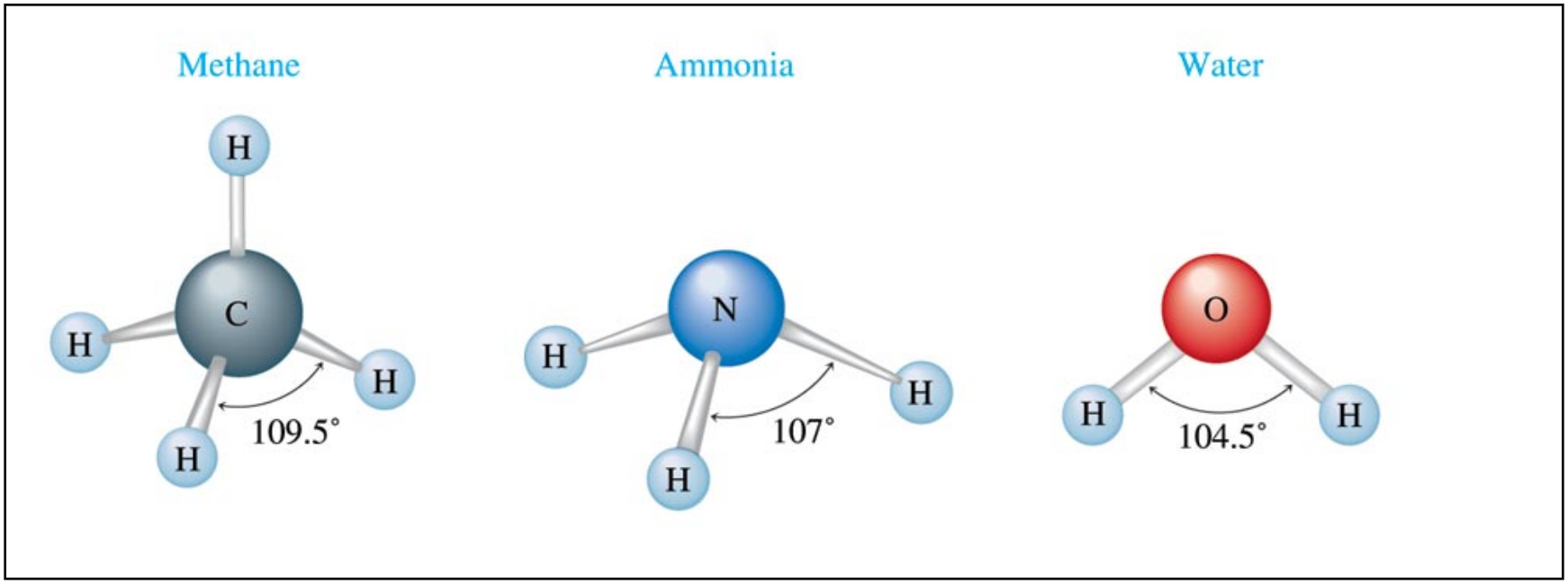


TABLE 9.3 Electron-Domain Geometries and Molecular Shapes for Molecules with Five and Six Electron Domains Around the Central Atom

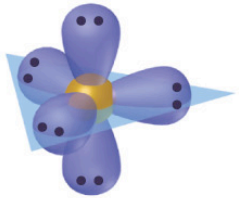
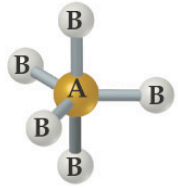
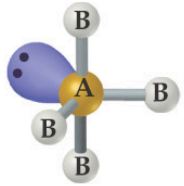
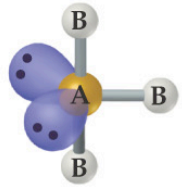
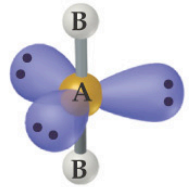
Total Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
5	 Trigonal bipyramidal	5	0	 Trigonal bipyramidal	PCl_5
		4	1	 Seesaw	SF_4
		3	2	 T-shaped	ClF_3
		2	3	 Linear	XeF_2

TABLE 9.3 Electron-Domain Geometries and Molecular Shapes for Molecules with Five and Six Electron Domains Around the Central Atom

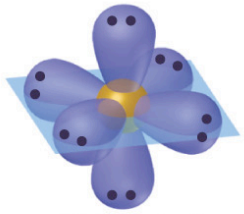
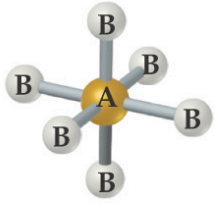
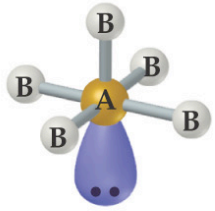
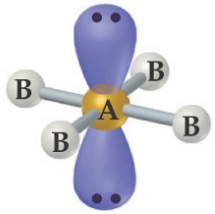
Total Electron Domains	Electron-Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Example
6	 Octahedral	6	0	 Octahedral	SF_6
		5	1	 Square pyramidal	BrF_5
		4	2	 Square planar	XeF_4

Figure 8.20 a & b Possible Electron Pair Arrangements for XeF_4

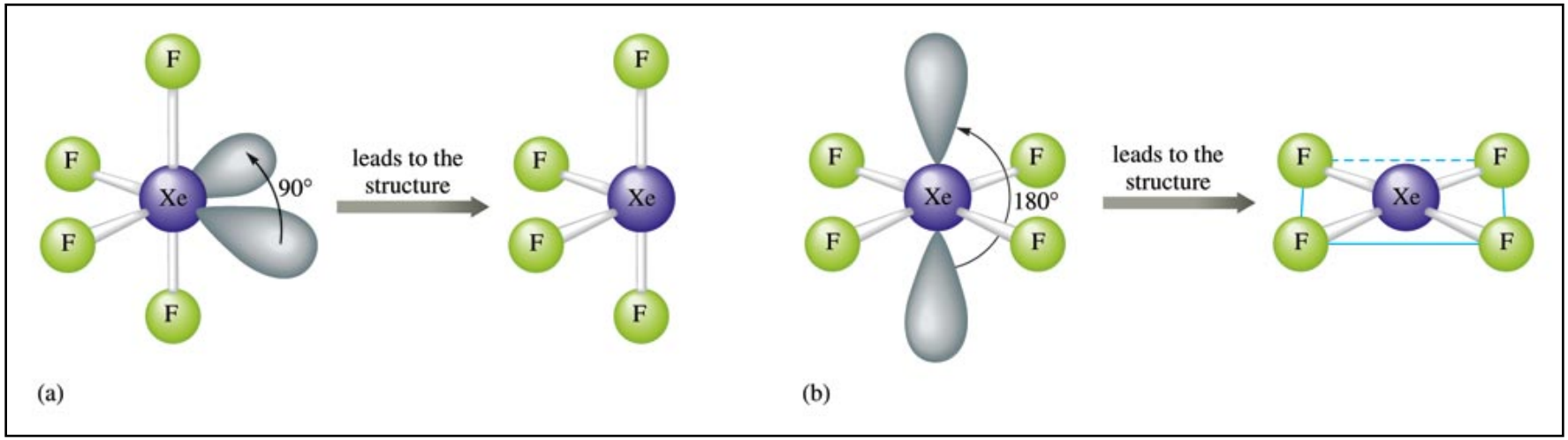


Figure 8.21 a-c Three Possible Arrangements of the Electron Pairs in the I_3^- Ion

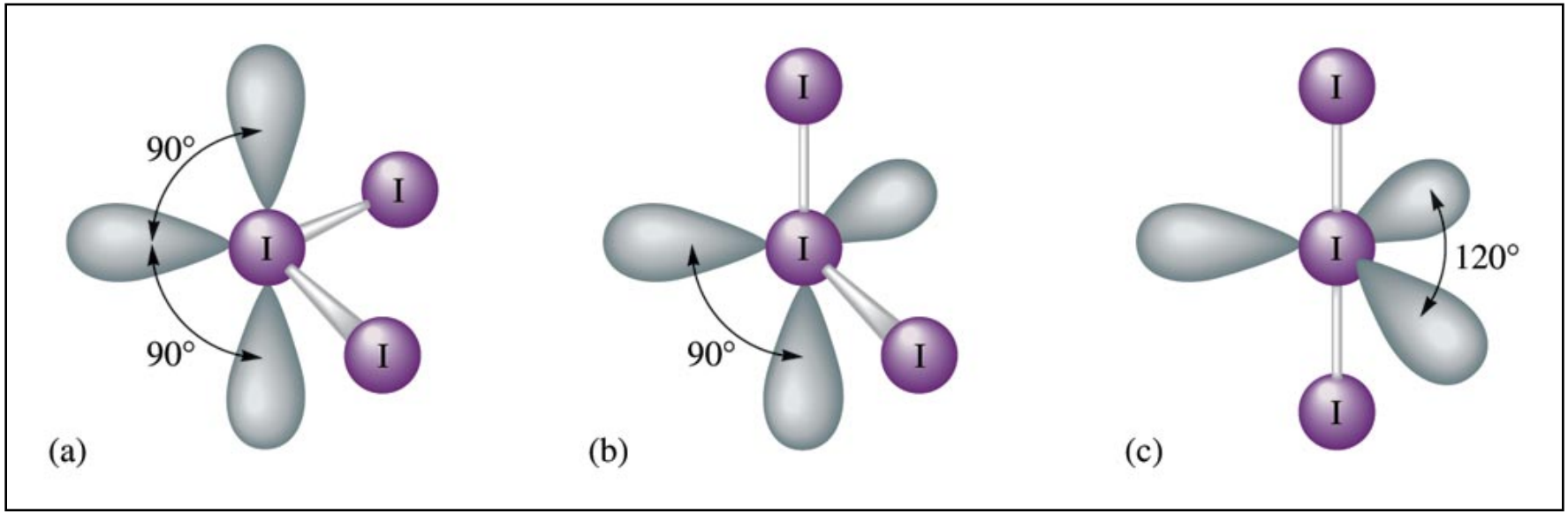


Figure 8.22 a-c The Molecular Structure of Methanol

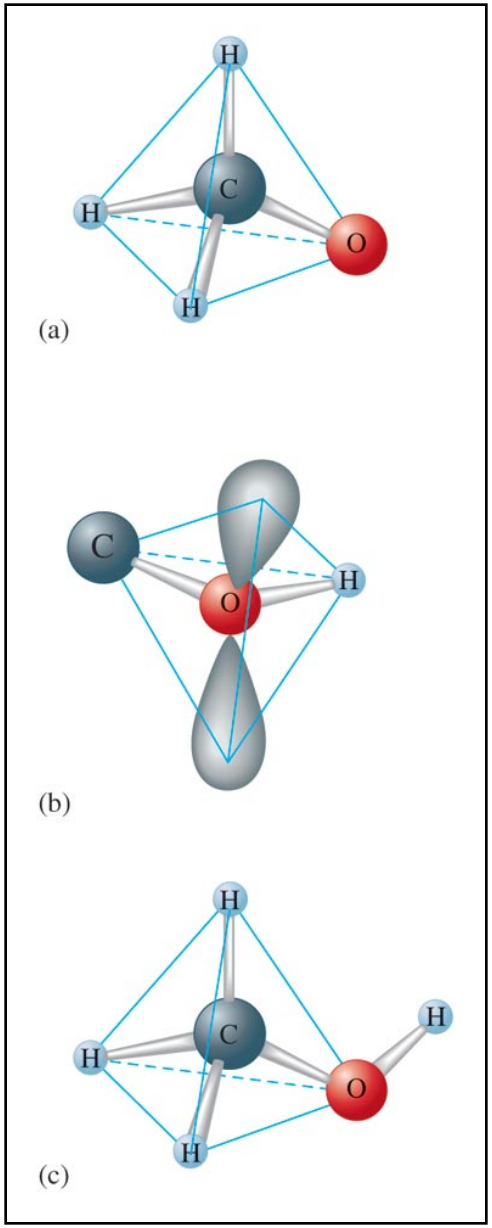


Figure 9.5 An Energy-Level Diagram Showing the Formation of Four sp^3 Orbitals

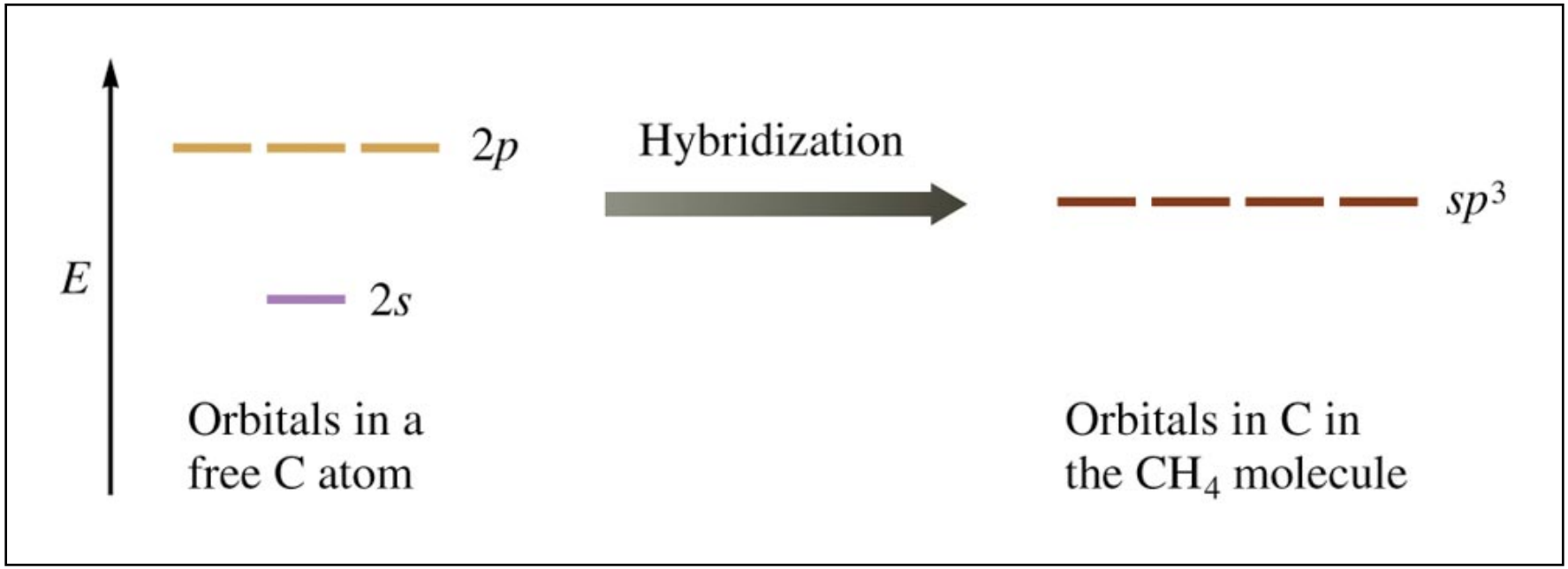


Figure 9.3 The Native 2s and Three 2*p* Atomic Orbitals Characteristic of a Free Carbon Atom are Combined to Form a New Set of Four sp^3 Orbitals

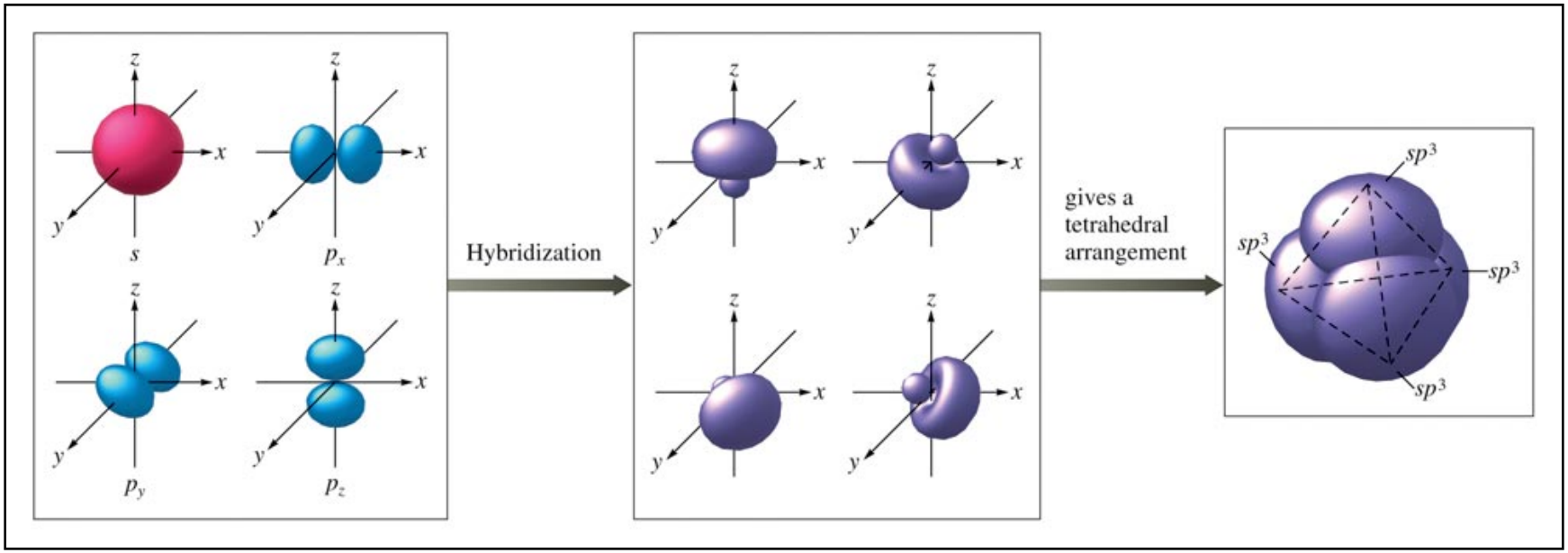


Figure 9.4 Cross Section of sp^3 Orbital

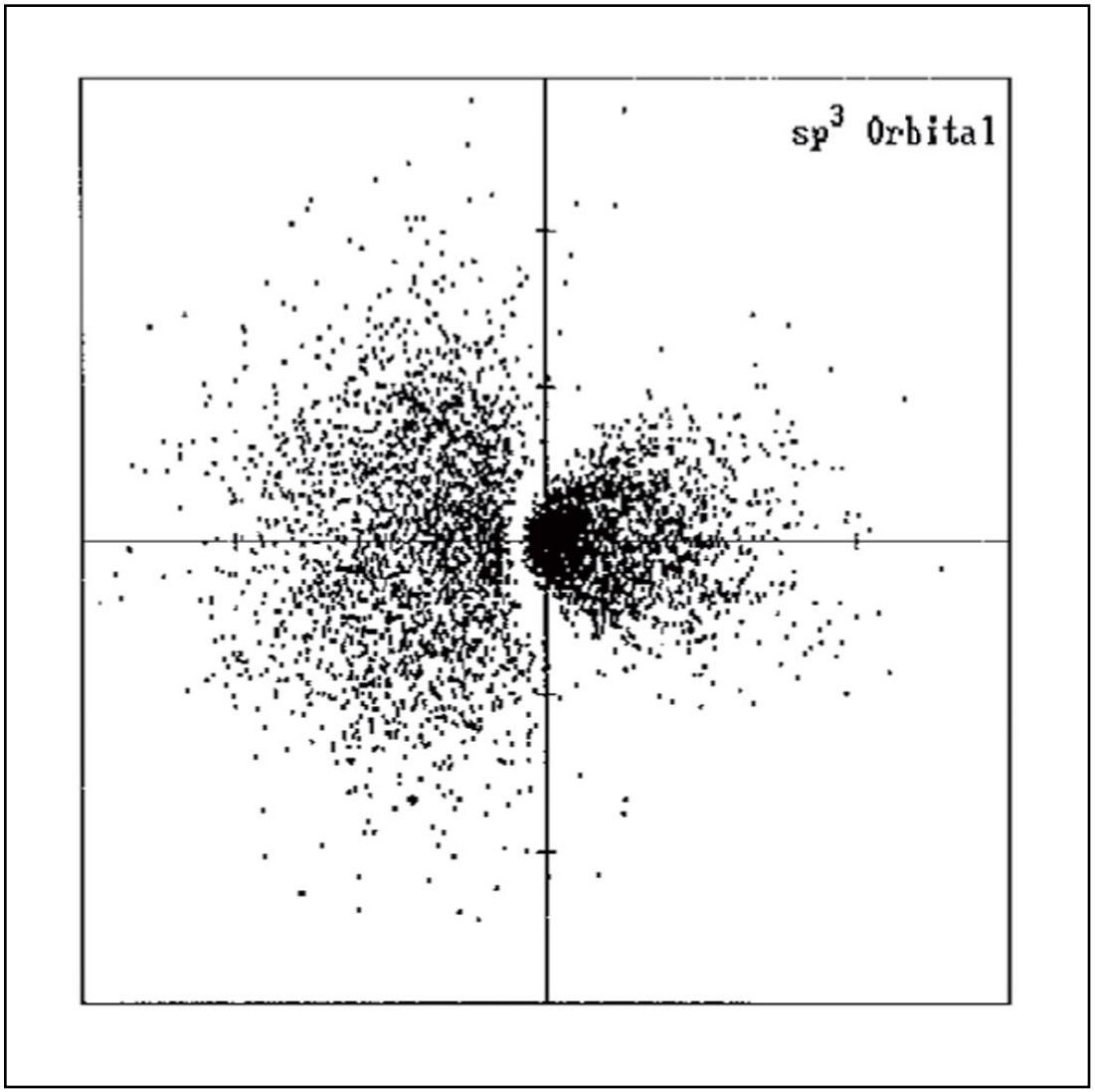


Figure 9.6 The Tetrahedral Set of Four sp^3 Orbitals of the Carbon Atom are Used to Share Electron Pairs with the Four 1s Orbitals of the Hydrogen Atoms to Form the Four Equivalent C-H

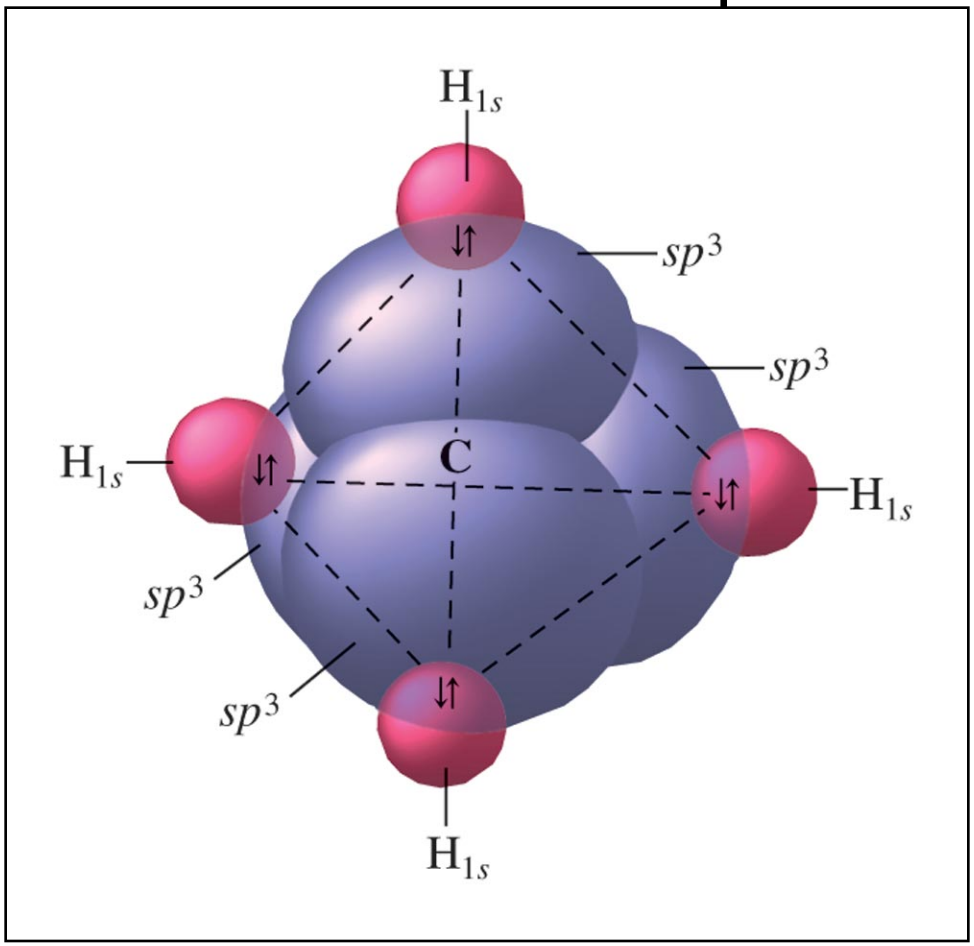


Figure 9.7 The Nitrogen Atom in Ammonia is sp^3 Hybridized

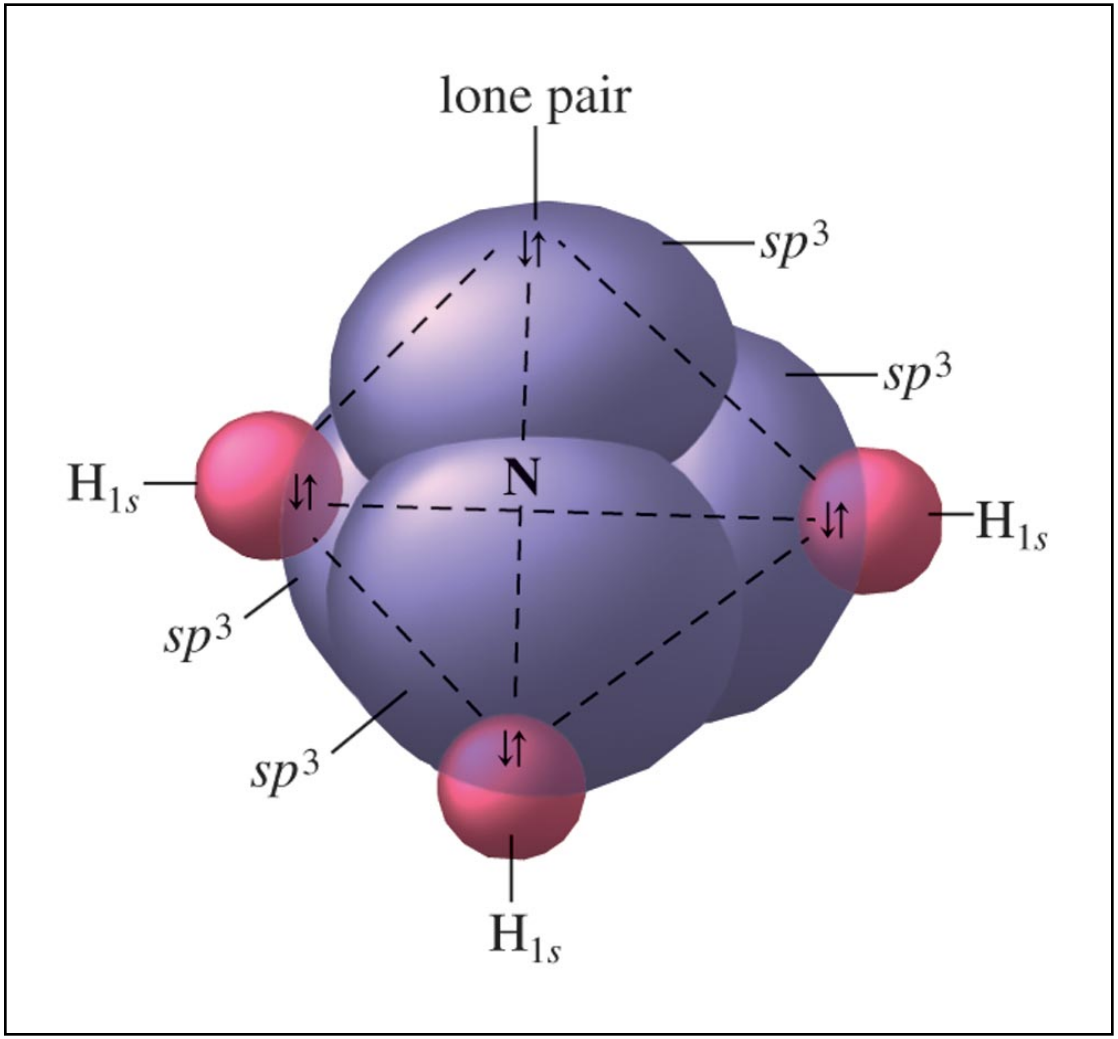


Figure 9.9 An Orbital Energy-Level Diagram for sp^2 Hybridization

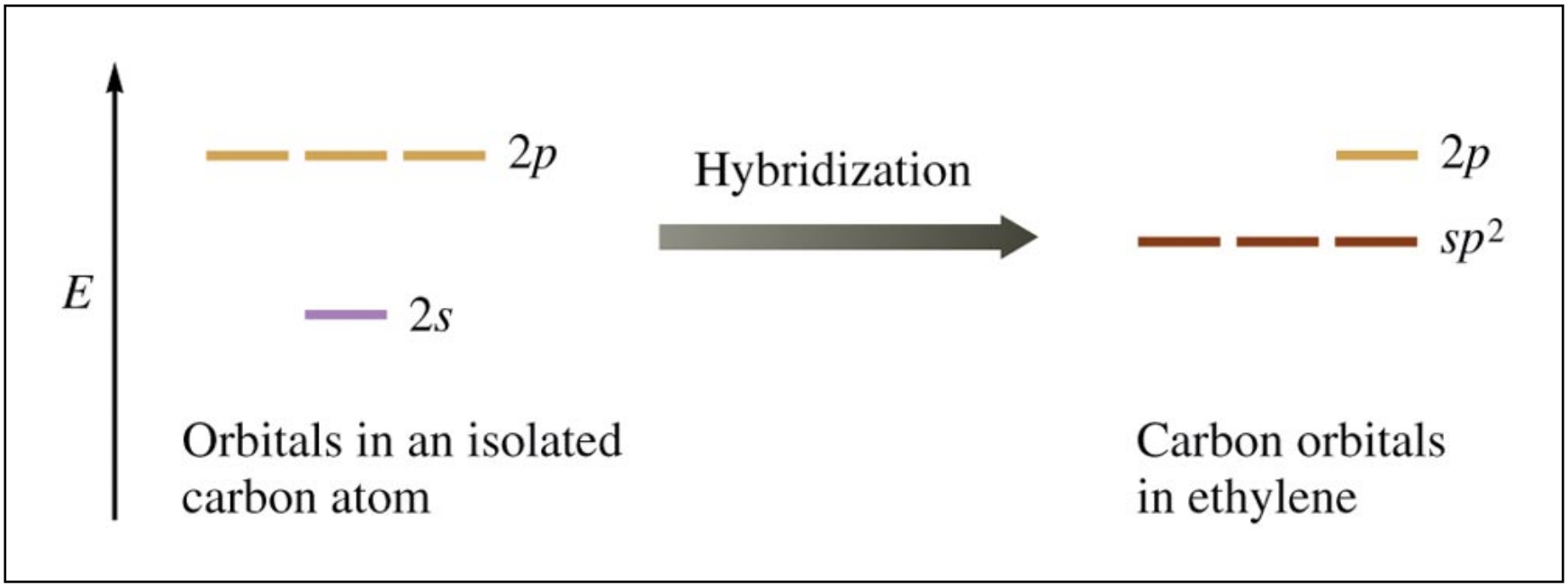


Figure 9.8 The Hybridization of the s, px, and py Atomic Orbitals Results in the Formation of Three sp^2 Orbtitals Centered in the xy Plane

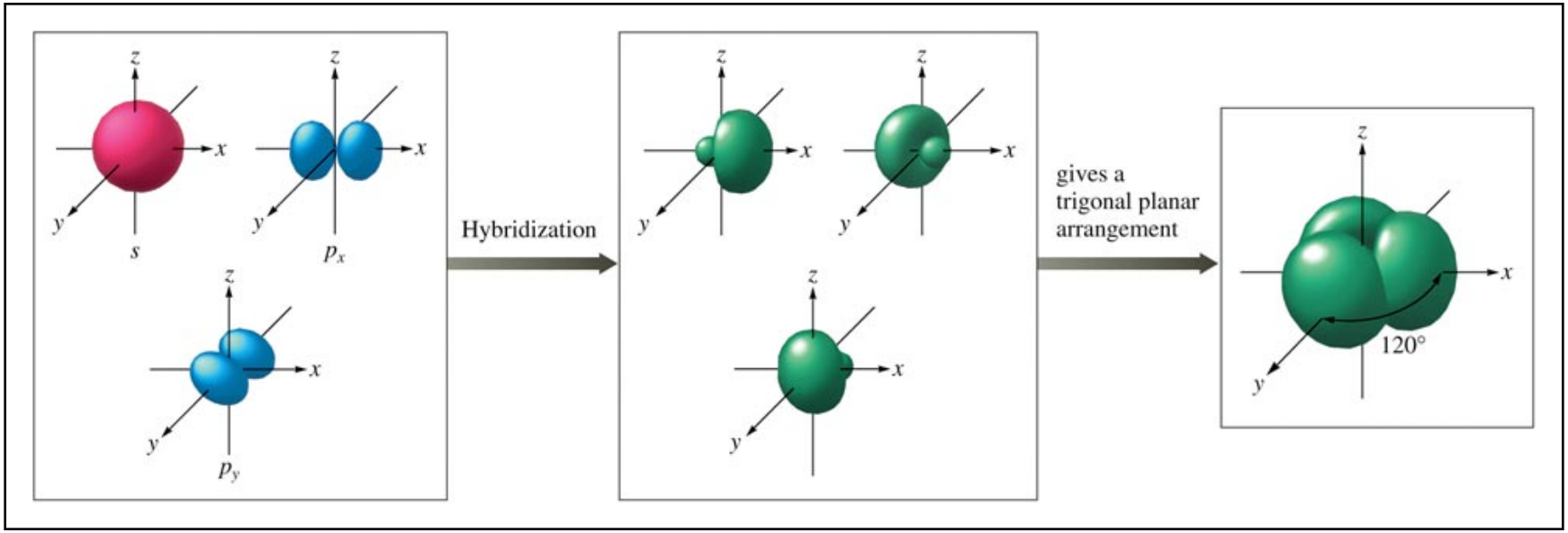


Figure 9.10 When An s and Two p Orbitals Are Mixed to Form a Set of Three sp^2 Orbitals, One p Orbital Remains Unchanged and is Perpendicular to the Plane of the Hybrid Orbitals

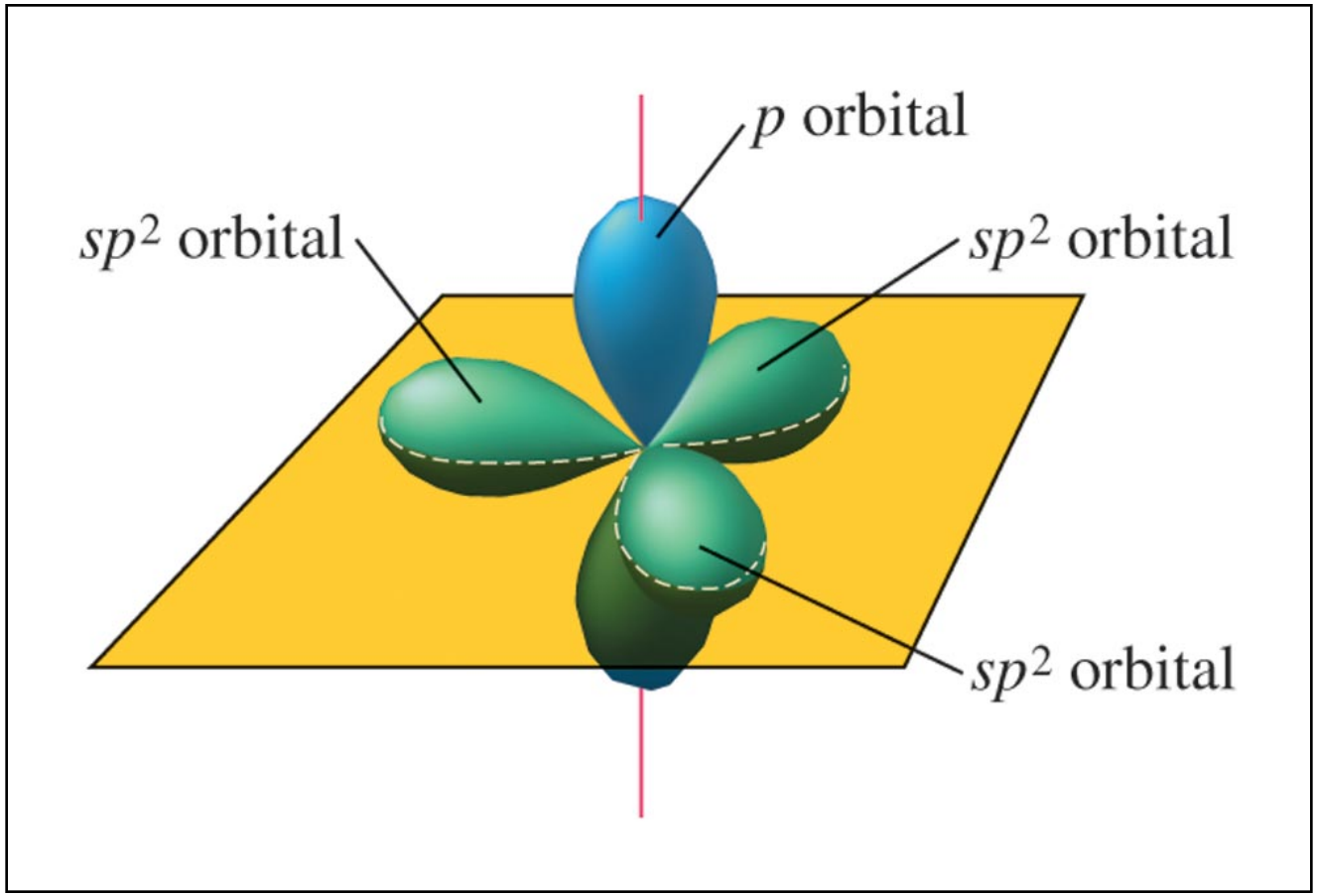
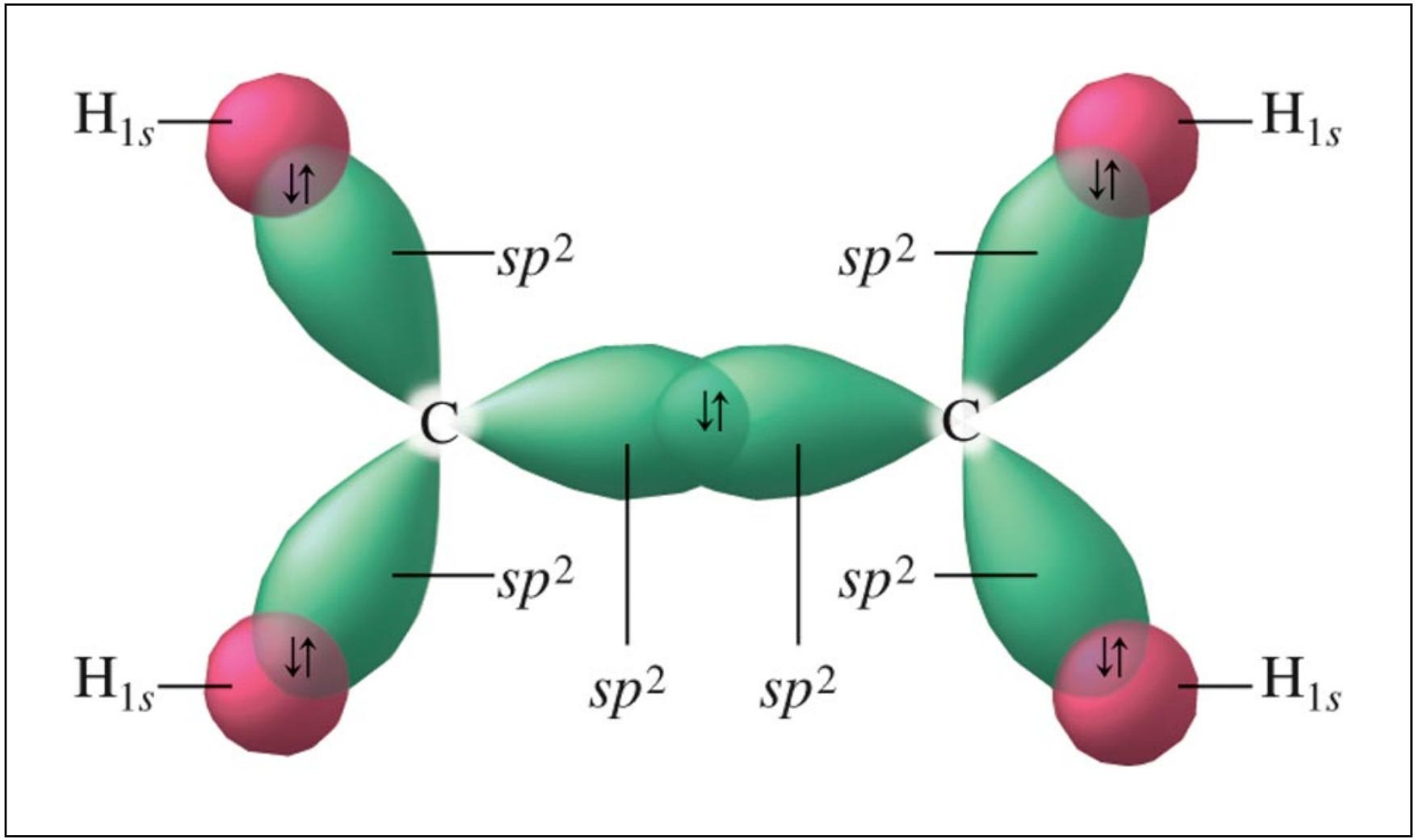


Figure 9.11 The Sigma Bonds in Ethylene



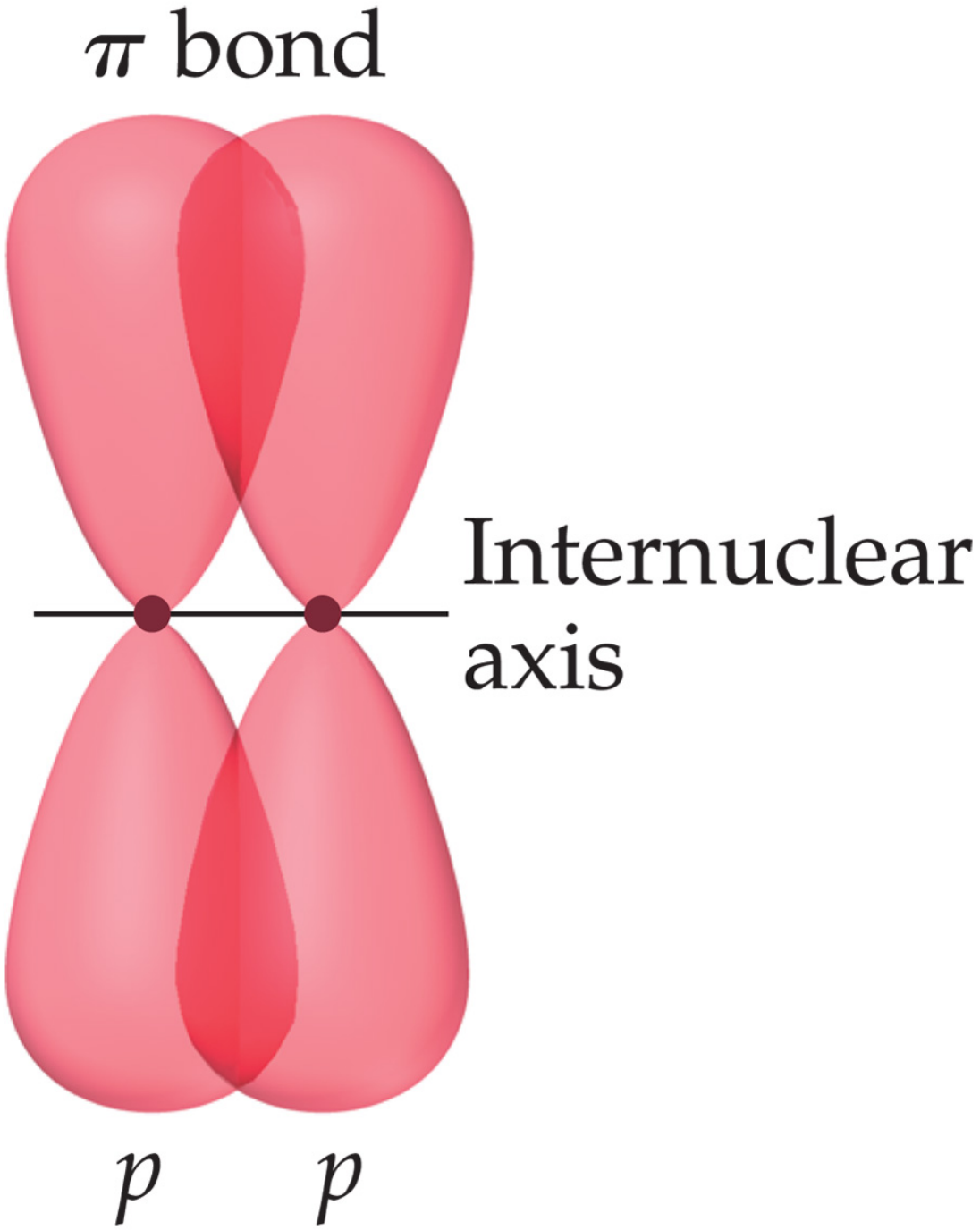


Figure 9.12 A Carbon-Carbon Double Bond Consists of a o and a pi Bond

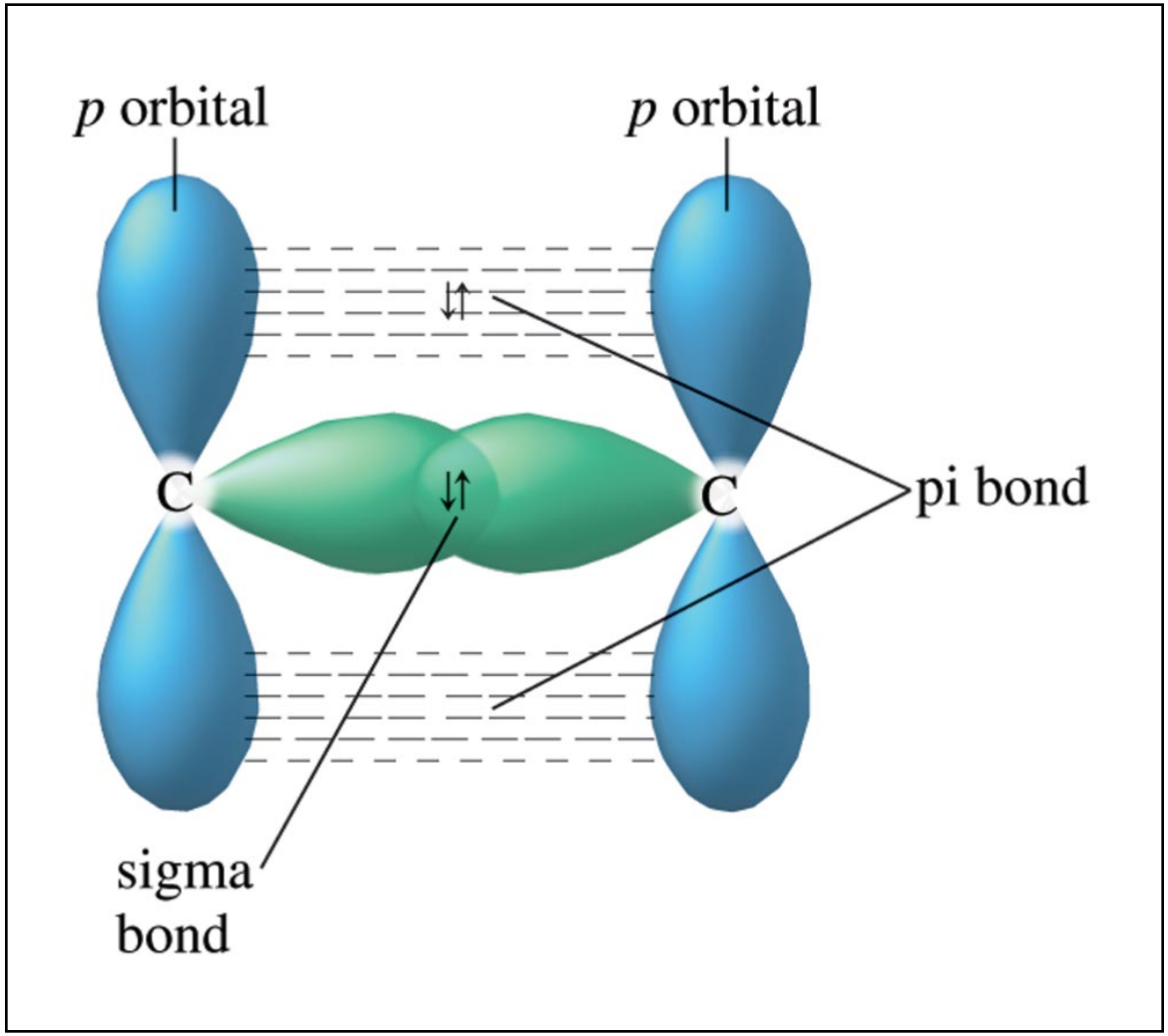
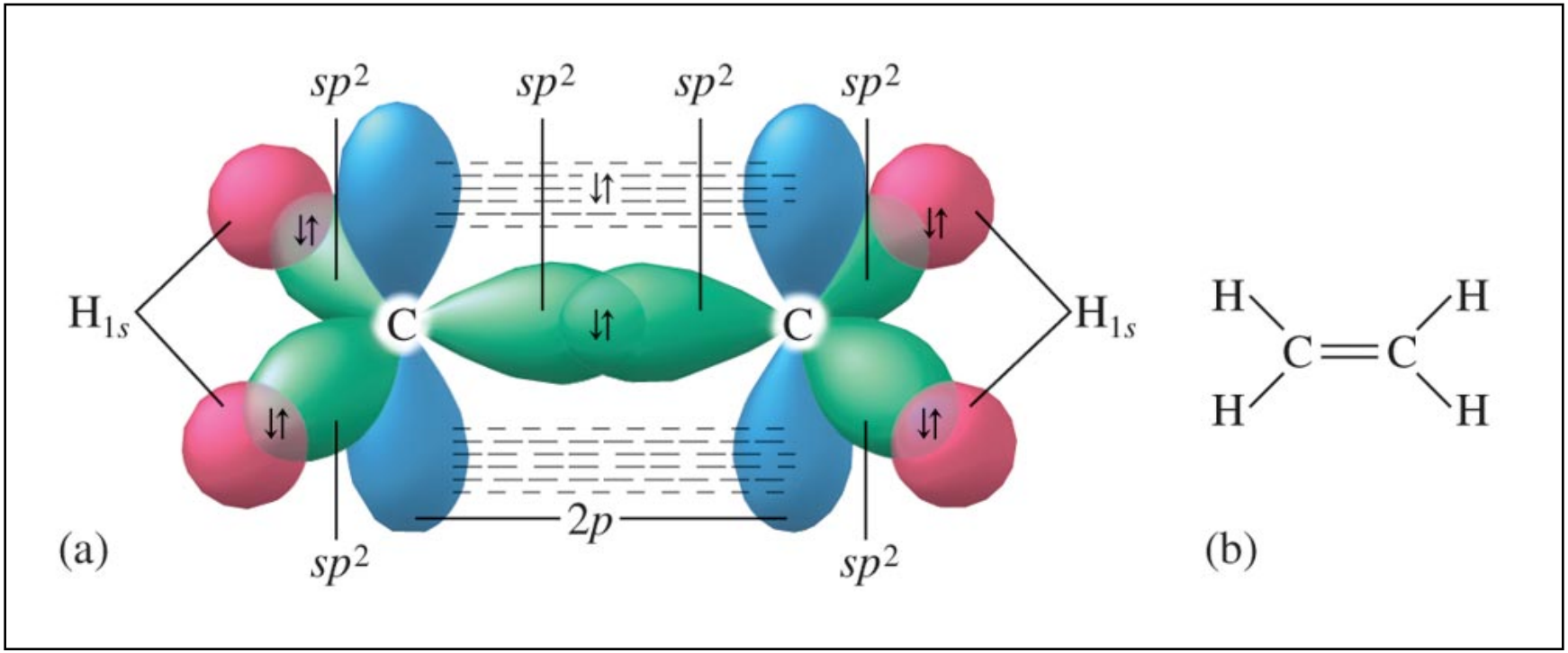


Figure 9.13 (a)The Orbitals Used to Form the Bonds in Ethylene (b) The Lewis Structure for Ethylene



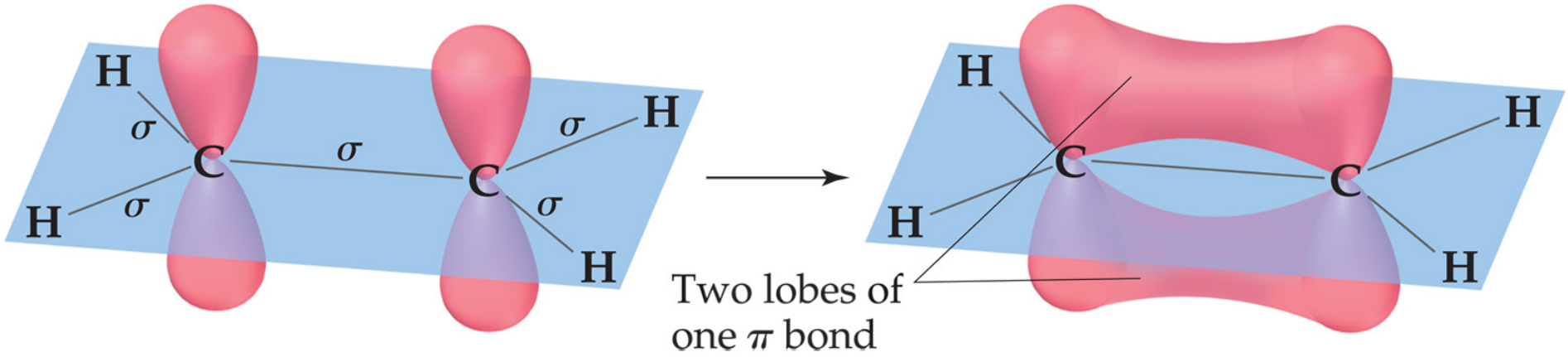


Figure 9.16 The Orbital Energy-Level Diagram for the Formation of *sp* Hybrid Orbitals on Carbon

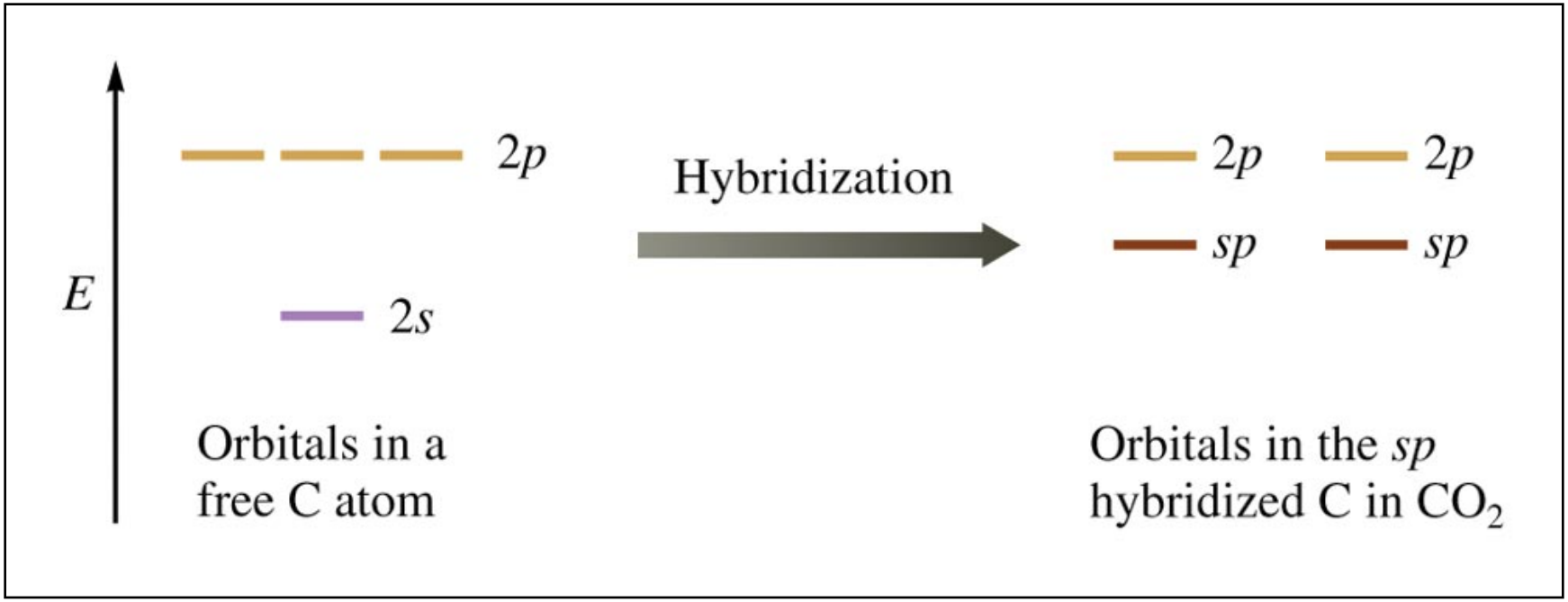


Figure 9.14 When One s Orbital and One p Orbital are Hybridized, a Set of Two sp Orbitals Orientated at 180 Degrees Results

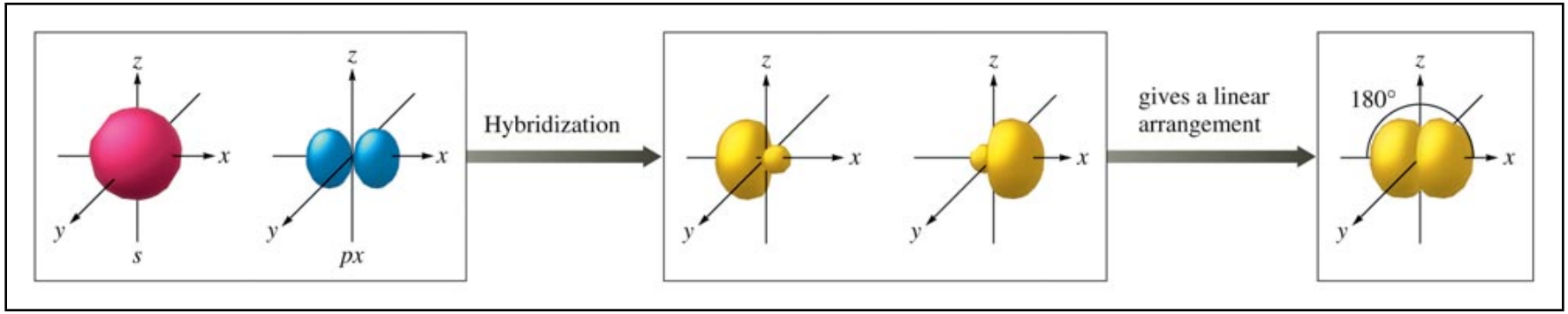


Figure 9.20 a-d (a) The *sp* Hybridized Nitrogen Atom (b) The o Bonds in the N_2 Molecule (c) The Two pi Bonds in N_2 Are Formed When Electron Pairs Are Shared between two Sets of Parallel *p* Orbitals (d) The Total Bonding Picture of N_2

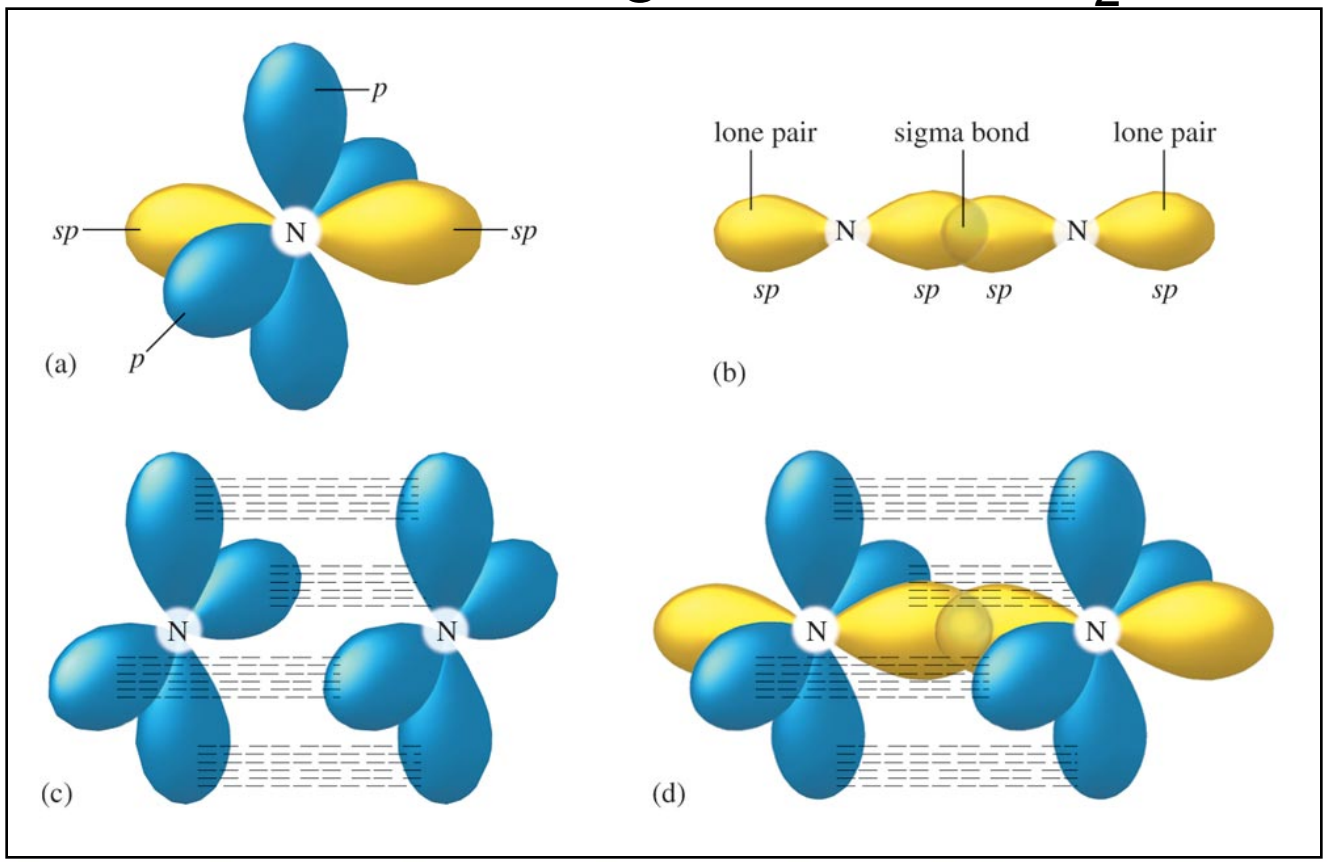


Figure 9.17 The Orbitals of an *sp* Hybridized Carbon Atom

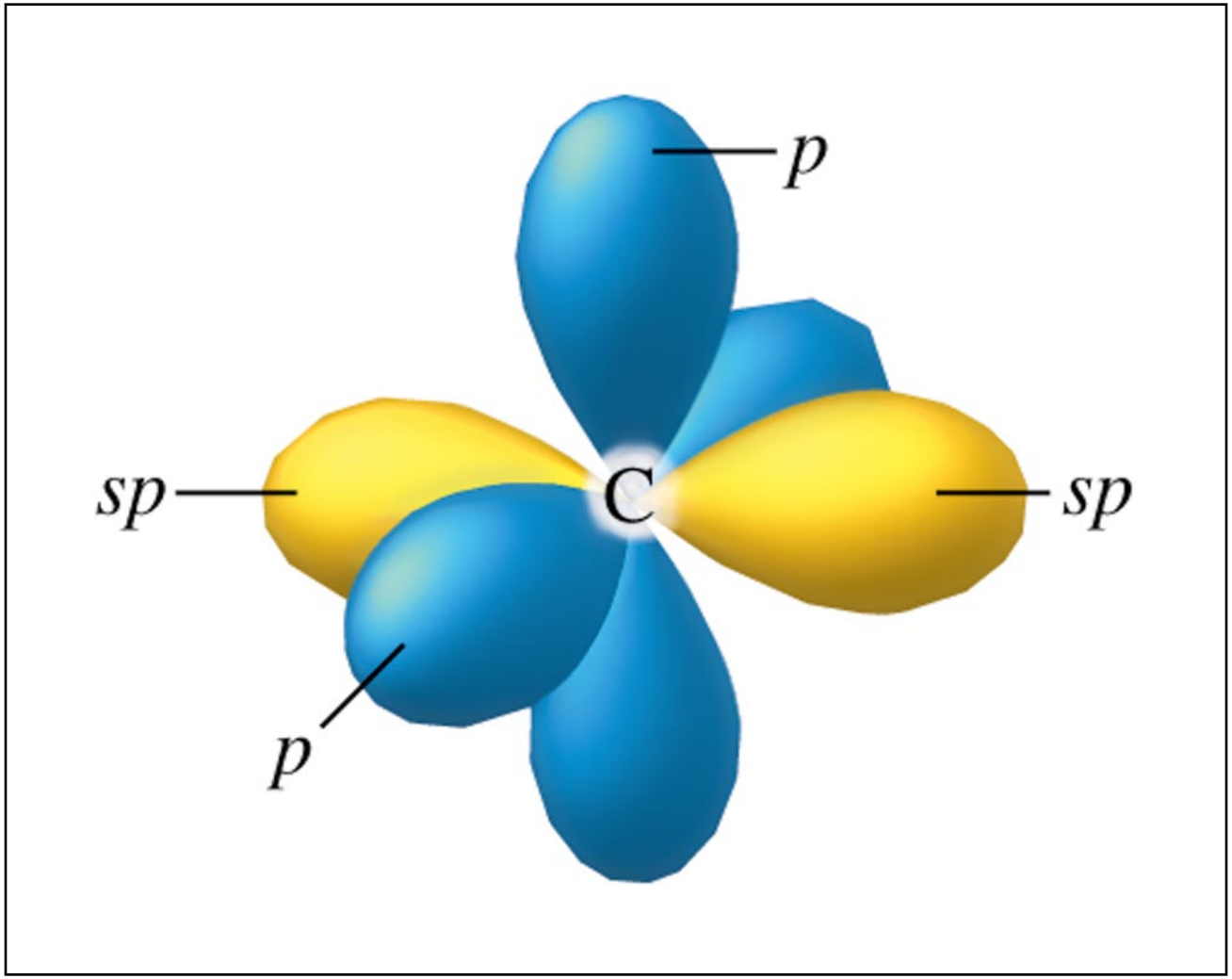


Figure 9.15 The Hybrid Orbitals in the CO_2 Molecule

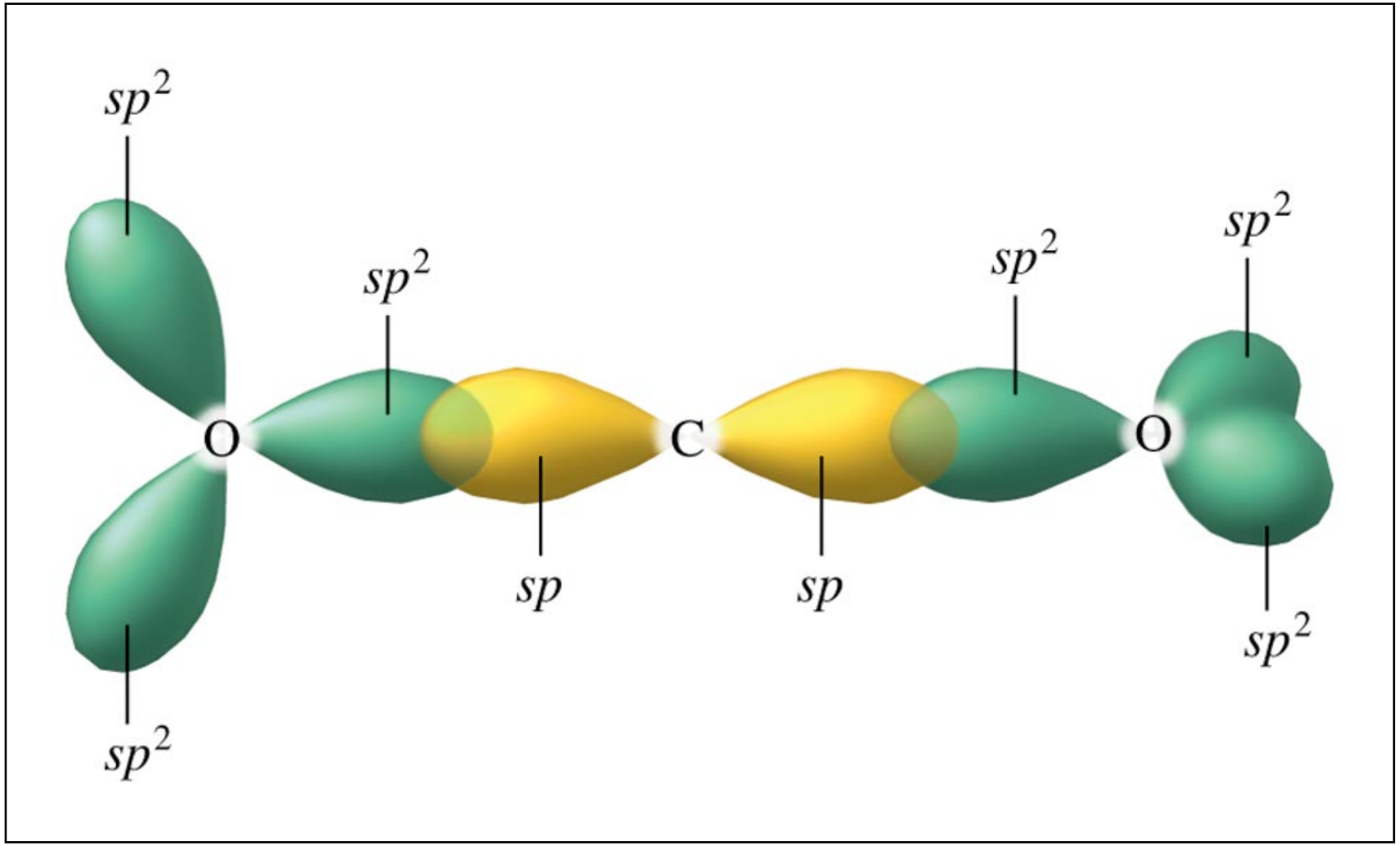


Figure 9.18 The Orbital Arrangement for an sp^2 Hybridized Oxygen Atom

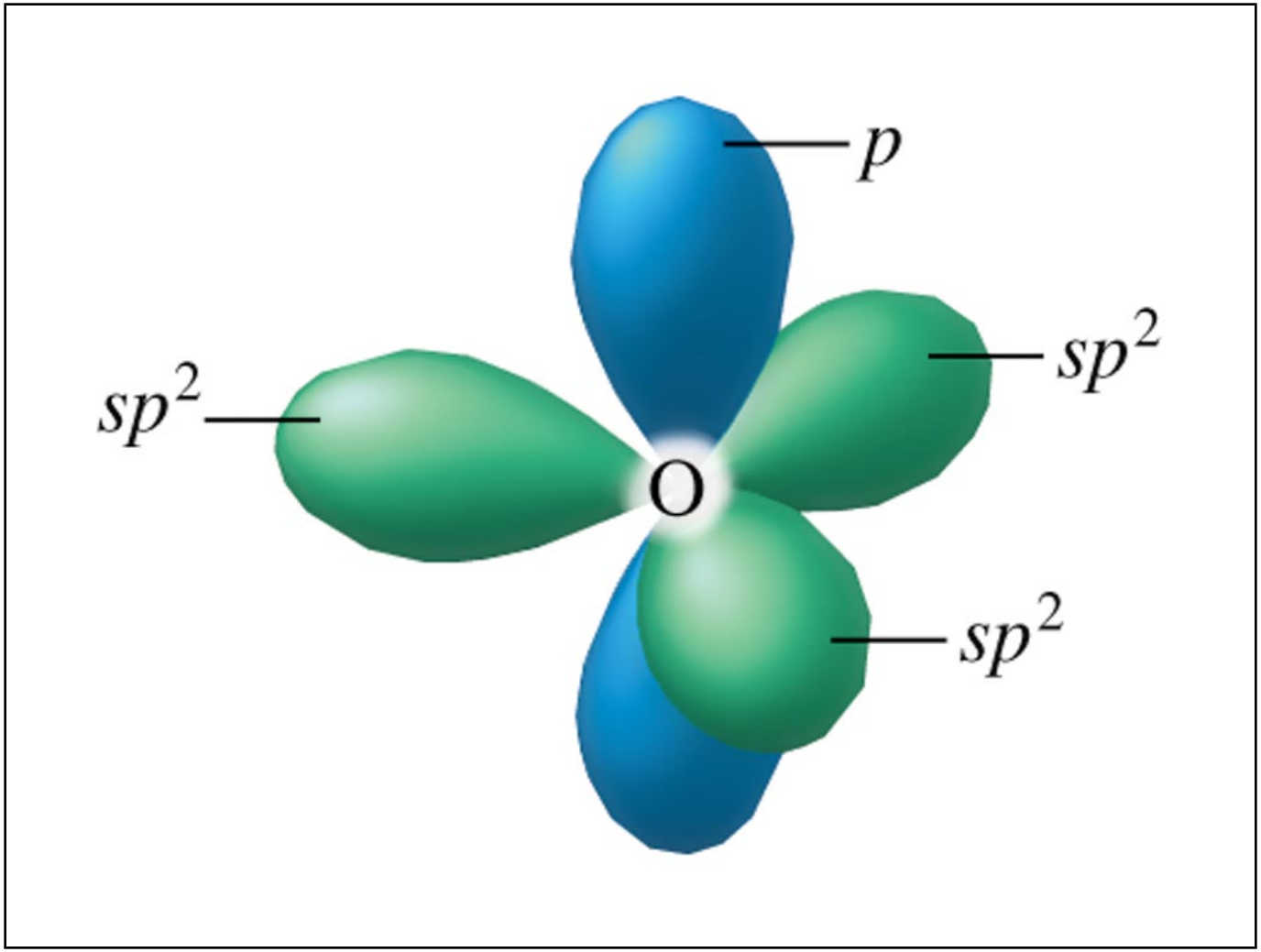


Figure 9.19 (a) The Orbitals Used to form the Bonds in Carbon Dioxide; Note that the Carbon-Oxygen Double Bonds Each Consist of One o Bond and One pi Bond

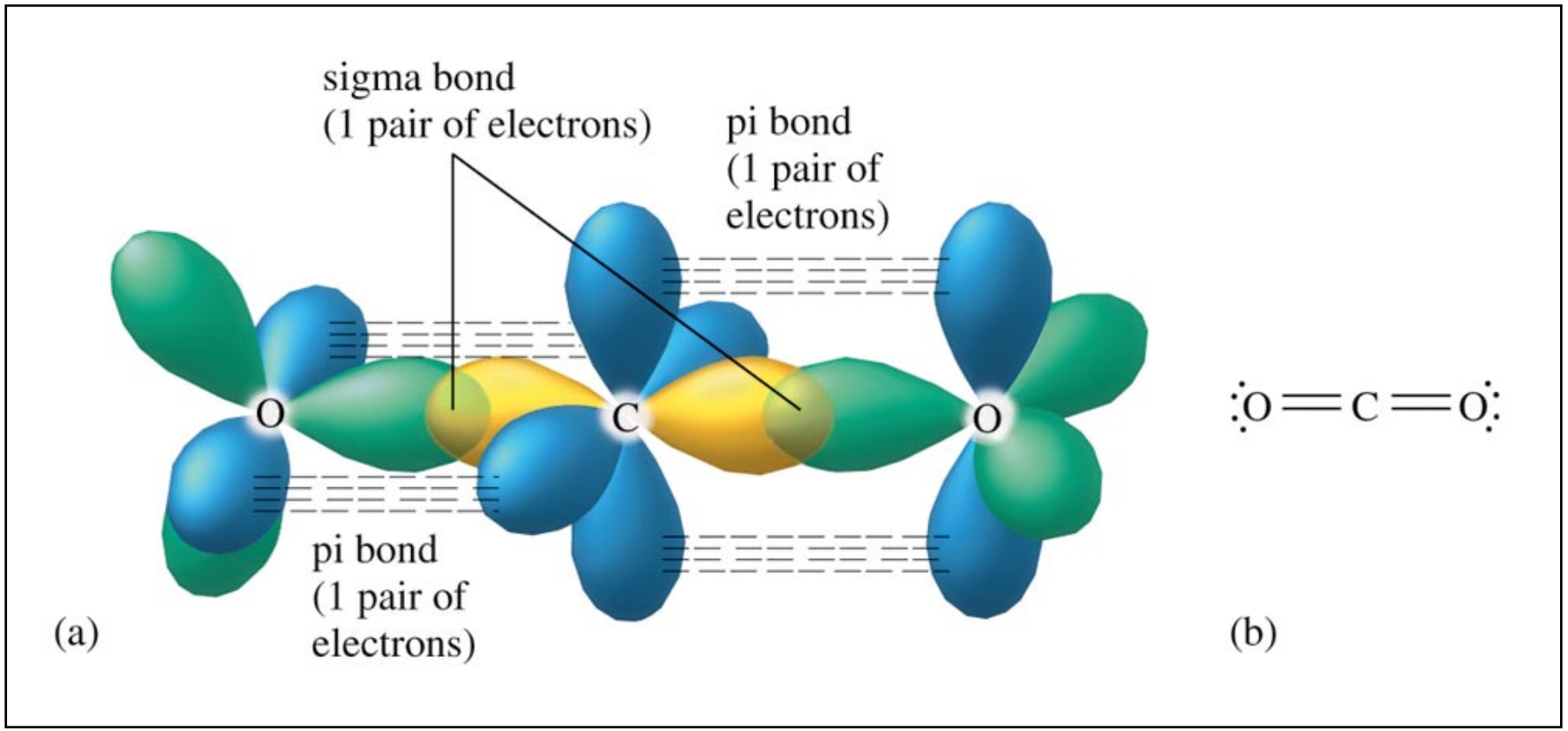


Figure 9.21 A Set of dsp^3 Hybrid Orbitals on Phosphorus Atom

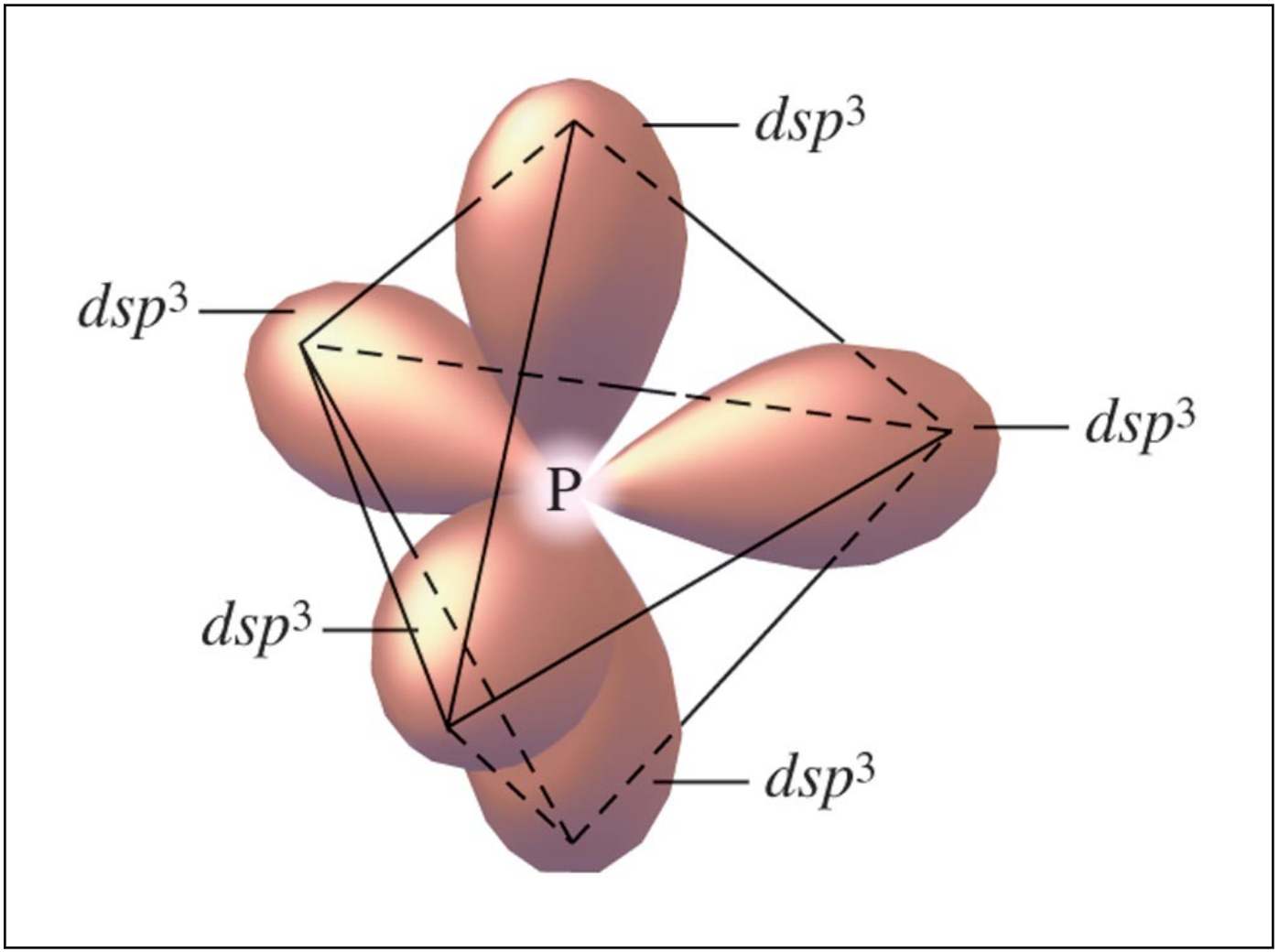


Figure 9.22b The Orbitals Used to Form the Bonds in PCl_5

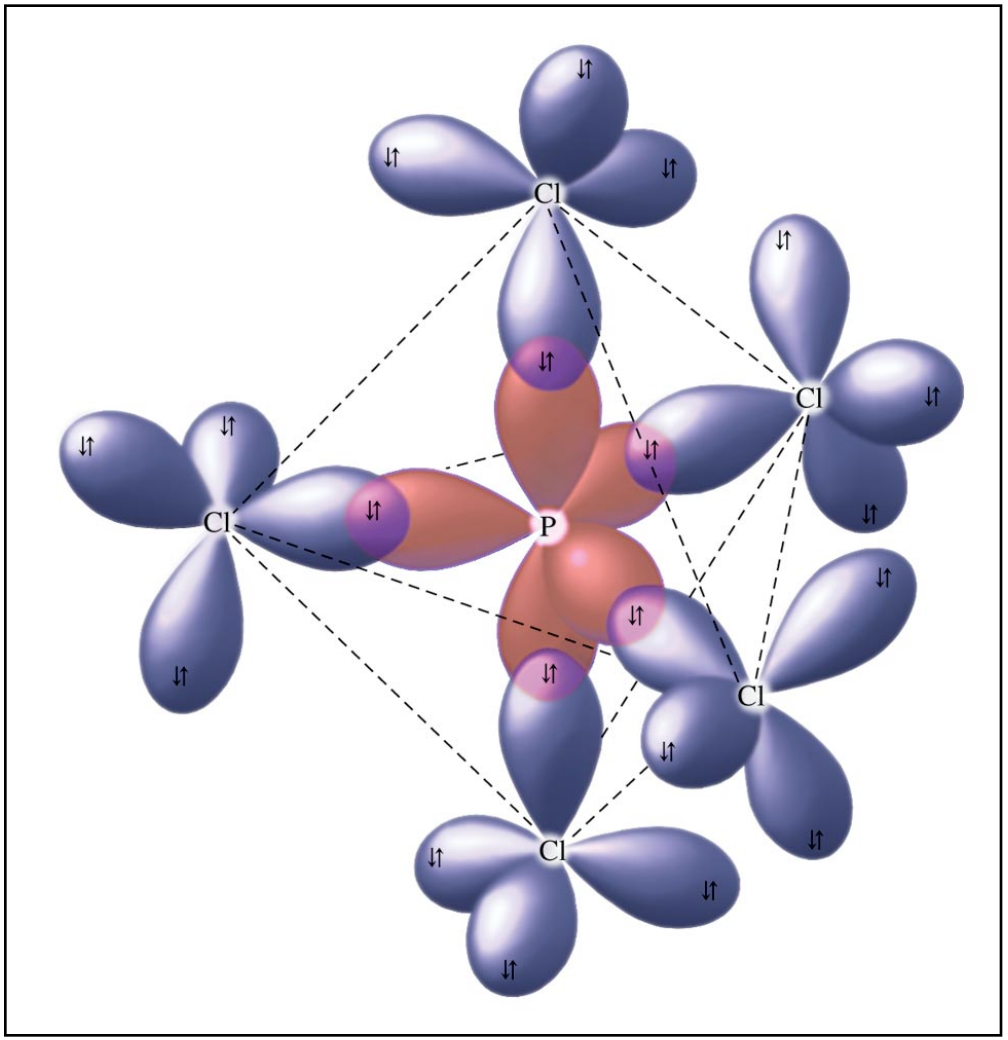
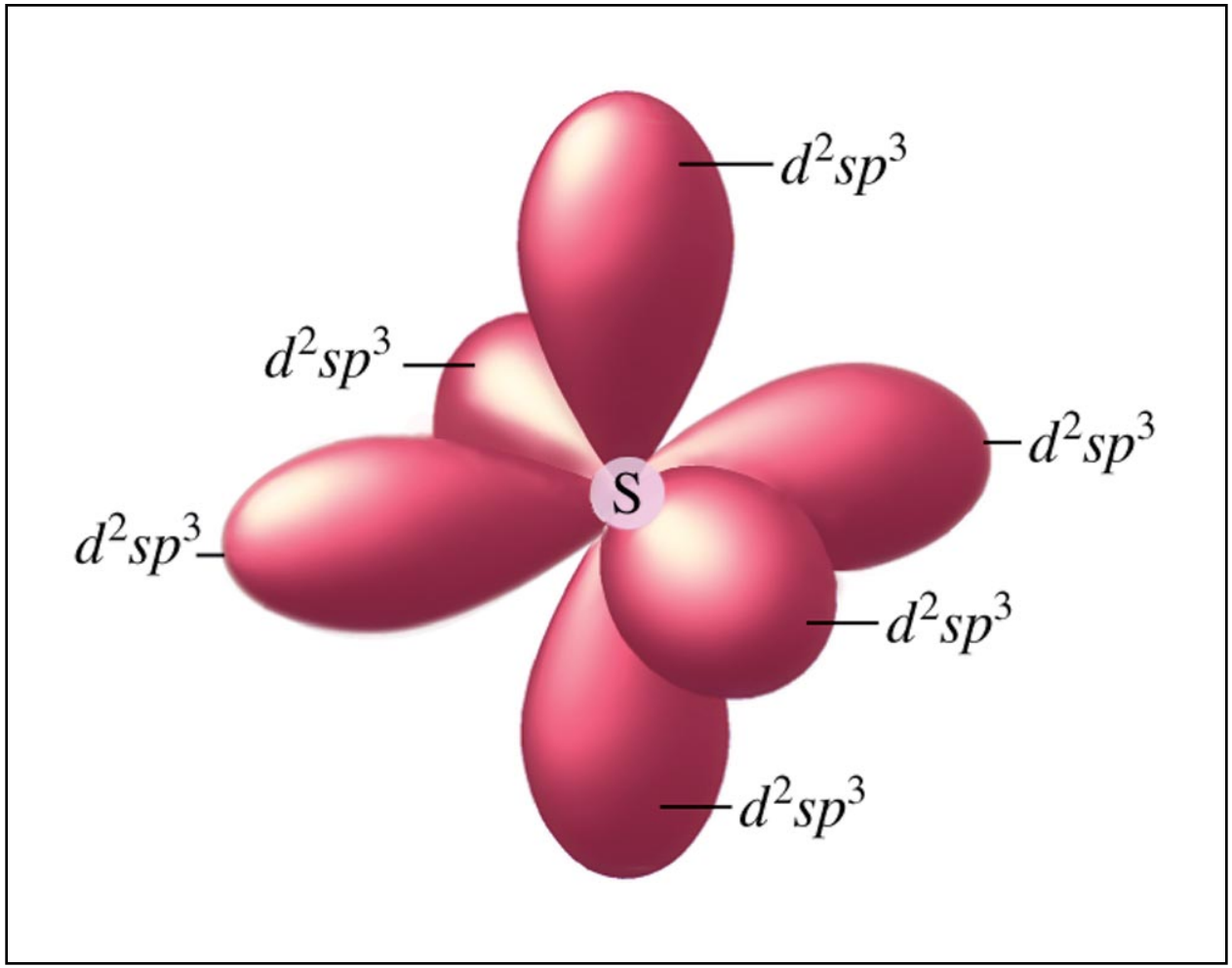


Figure 9.23 An Octahedral Set of d^2sp^3 Orbitals on Sulfur Atom



Xenon

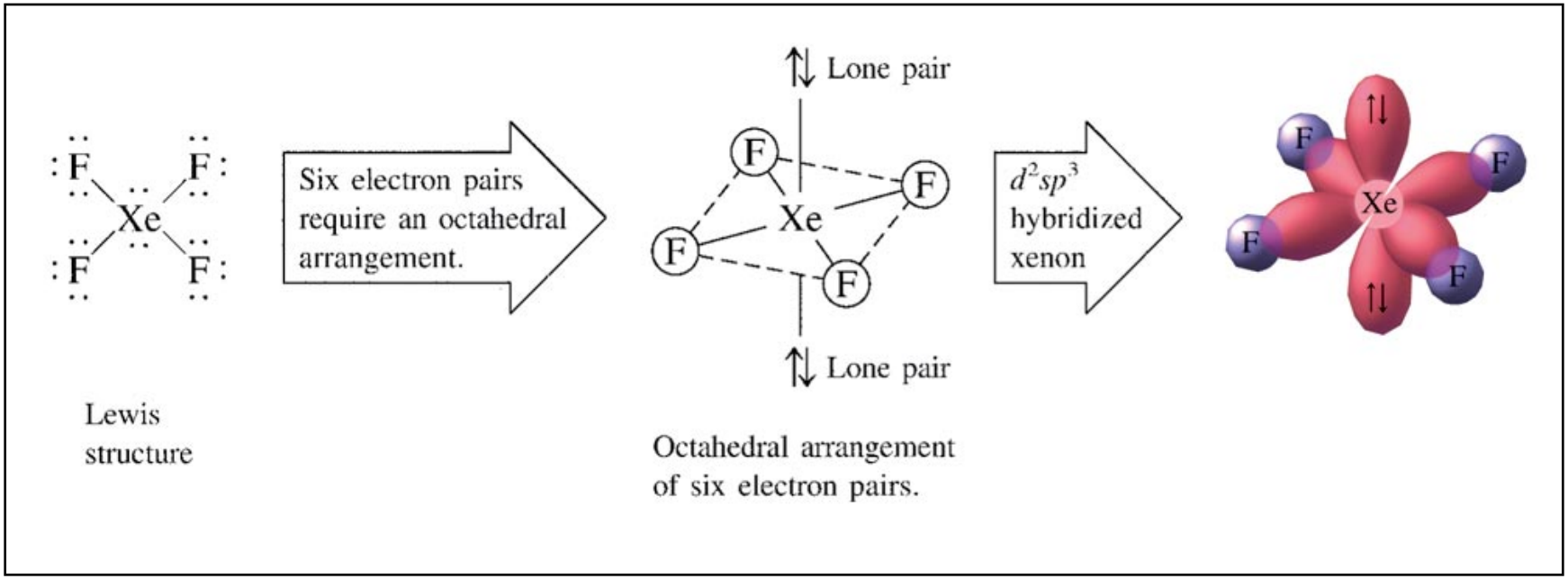
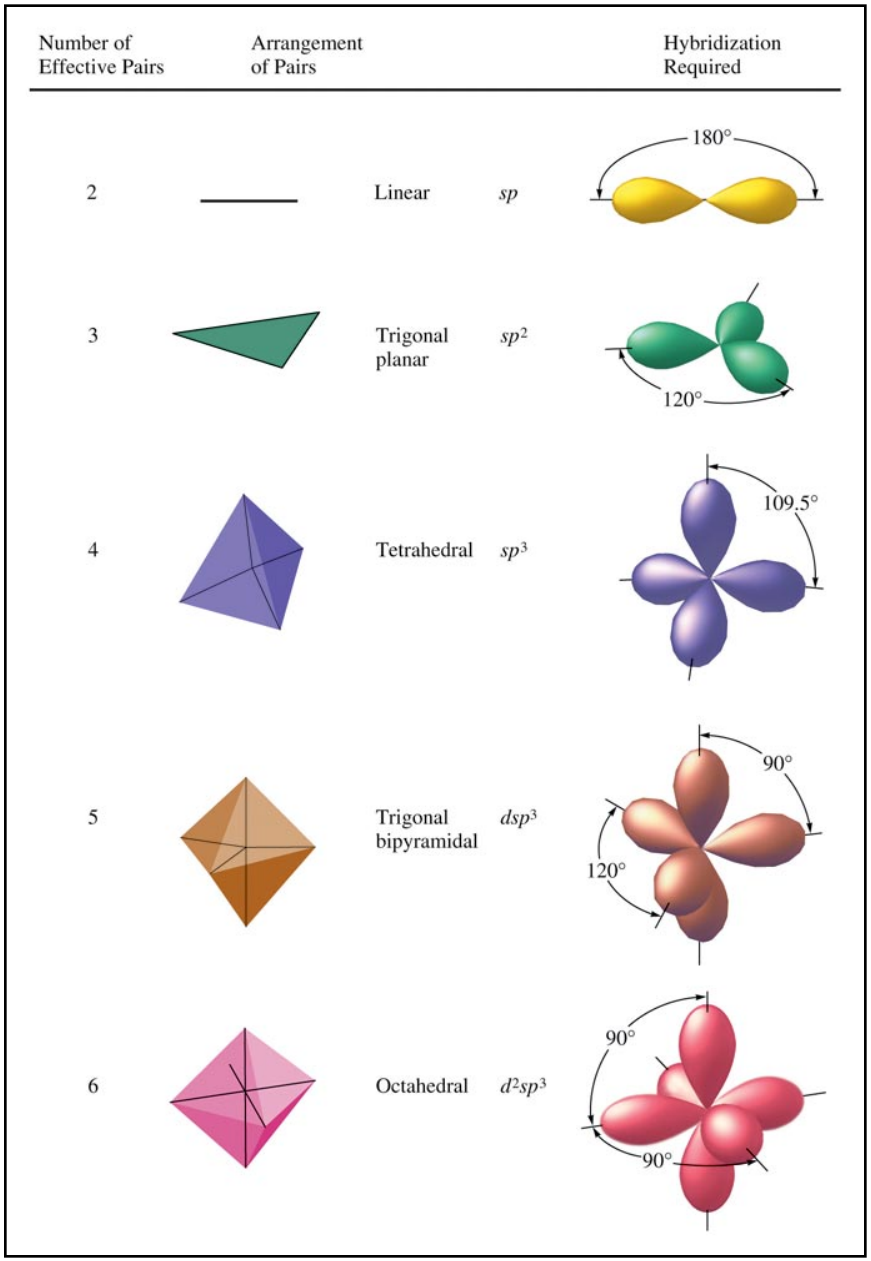
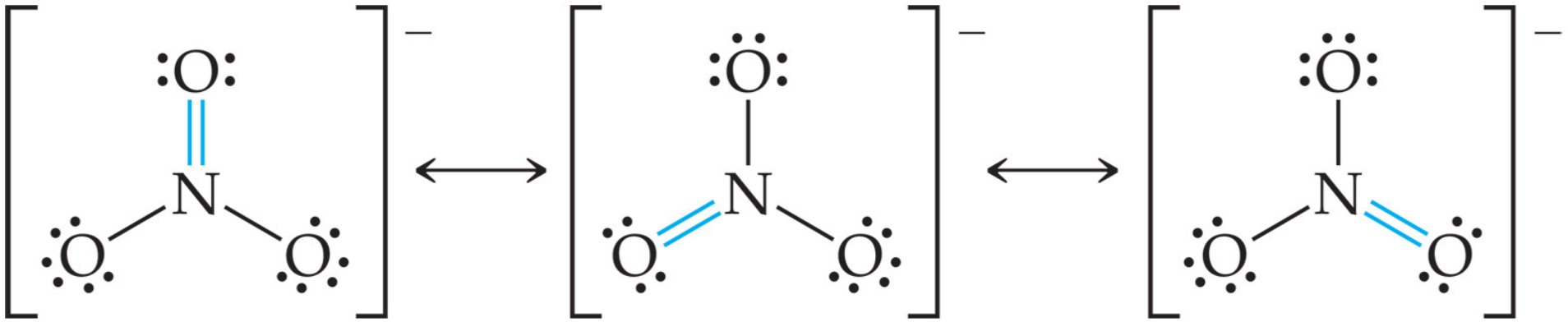
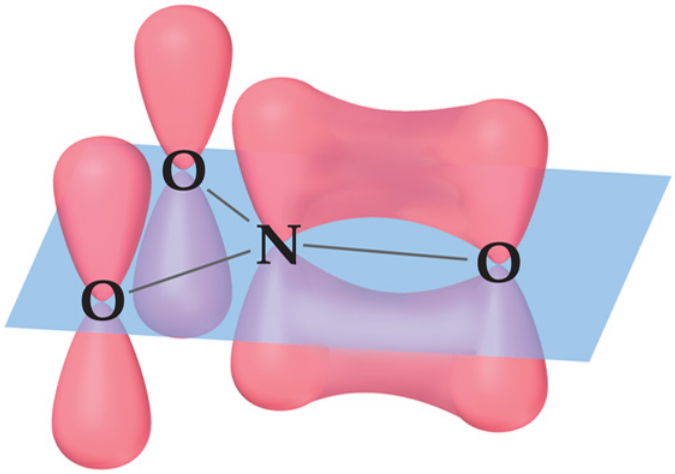


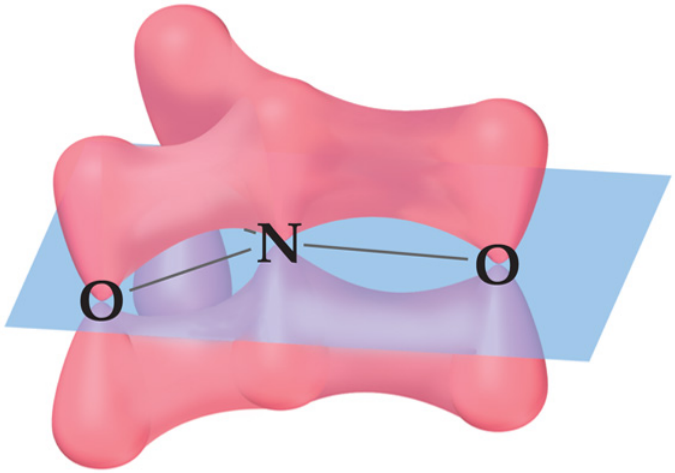
Figure 9.24 Relationship of the Number of Effective Pairs, Their Spatial Arrangement, and the Hybrid Orbital Set Required





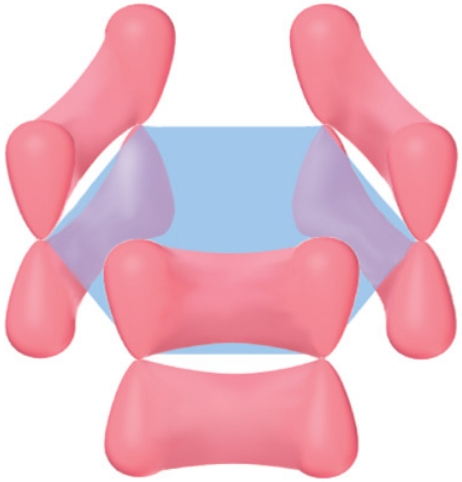


(a) N—O π bond in one of the resonance structures of NO_3^-.

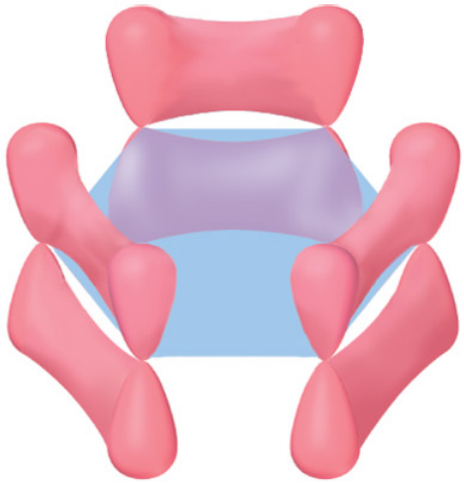


(b) Delocalization of the π bonds in the NO_3^- ion.

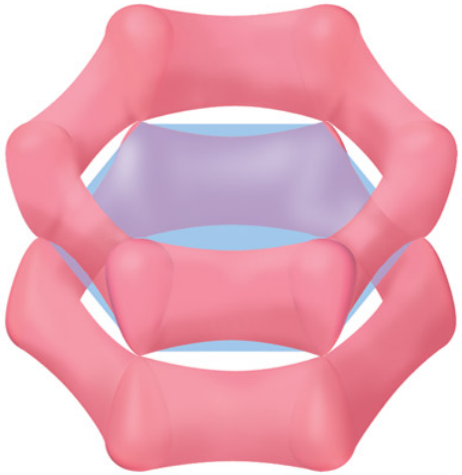
Explaining Resonance in Benzene



(a) Localized π bonds



(b) Localized π bonds



(c) Delocalized π bonds